January 2008

Science Reporter

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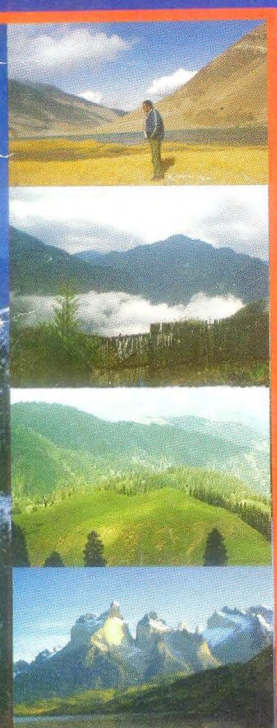
Call of The Mountains



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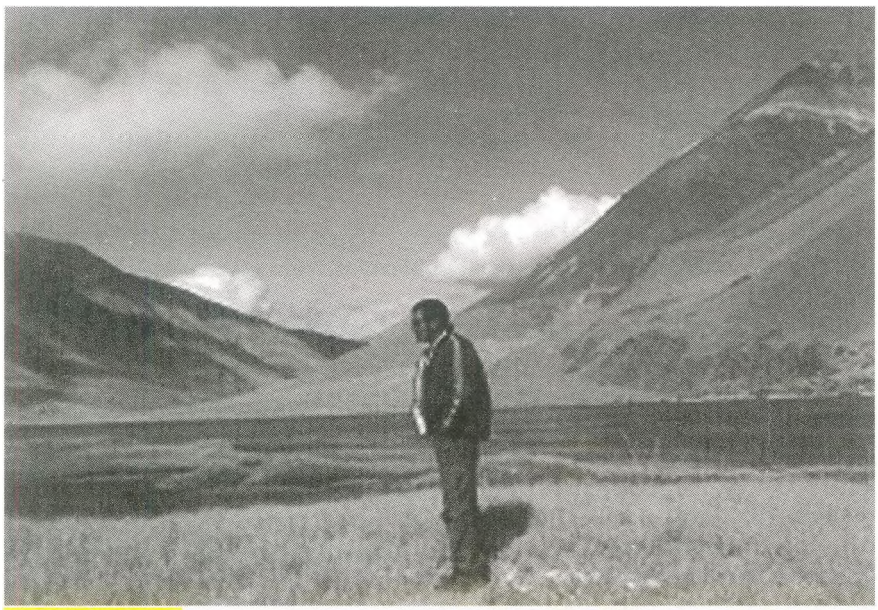
- Breathing Concepts
- Carbon Credits
- Quiz and Crossword
- Fiction and Puzzles
- In the Picture
- Strange Plants

New Columns

Science Reporter

Vol. 45 No. 1 January 2008 ISSN 0036-8512
National Institute of Science Communication And Information Resources (NISCAIR), CSIR



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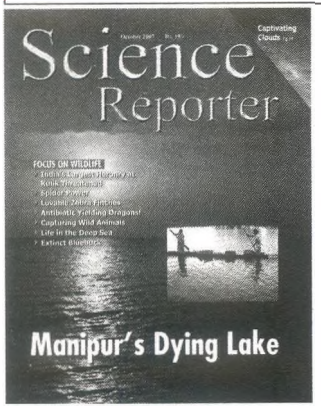

Care For The Rare

Your focus issue on wildlife (SR, October 2007) was really a milestone. It was really pitiful and disheartening to go through articles like Dying Loktak Lake and Threatened Kulik Sanctuary. I was full of remorse. Indeed the story does not end here, almost all the Ramsar sites of India are suffering due to intense anthropogenic interference. Not only the wetlands and forests but also the marine ecosystem is affected too.

People in the coastal areas are continuously destroying and killing the beautiful fringing coral reefs and other marine animals for selling in the market. We feel highly proud buying the dead remains of these animals and keeping them in our house only for show purposes. Indeed, these practices invite ecological imbalance. This is indeed shocking; we are digging our own graveyard.

As a conservationist, I feel that the earth is our only home and we can really change if we care enough and make a better world for all. Many species have said final good-byes and only the contrails of their remains are left in the form of fossils.

I once again convey thanks to the editor and the author for presenting such an issue and I hope this will be replicated once again in the future because alarm bells concerning eco-conservation have started to ring.

Rahul Rohitastwa
Bhagalpur (Bihar)

Fuelling Mozart Effect

Your cover article on music (Music to Your Ears, September, 2007) was very interesting and useful written in a lucid and methodological way. It is not an exaggeration to say that music is the language of the soul and thus it washes out the blemishes of life. According to recent researches, babies exposed to classical music end up smarter. Music has a tremendous influence on the brain, and a multilayered influence on the individual from modulating mood to alleviating stress.

Rahul Rohitastwa
Bhagalpur (Bihar)

Man and the Sea

The article Incredible Life in the Deep Sea by C.B. Ganesh (SR, October 2007) provided a fascinating glimpse of sea creatures and how they, in their struggle for existence, have fabulously adapted themselves to their harsh habitat. Man has an abiding interest and has to interact with it in a number of ways. But it is a hostile environment because marine animals such as starfish, sea urchins, sharks and eels are capable of inflicting wounds. Dermatitis can be induced because of corals, octopuses, sea urchins, sea snakes (all are poisonous, some more than the cobra), stingrays etc. It may be recalled that this year an Australian wild life enthusiast, who featured prominently in several breathtaking TV aerials connected with the animal kingdom, met his end probably due to a bite from a stingray. The sting from the stonefish (*Synanceja verucossa*) is very painful and may cause unconsciousness, delirium, convulsions, vomitting and even death. Danger also lurks from giant kelps and dermatitis producing seaweeds.

Dr S.K. Gurtu
Jaipur

ATTENTION AUTHORS

- We receive hundreds of articles every month from our esteemed readers. Efforts are made to acknowledge all the articles within 15 days of receipt.
- All the articles received are screened against several parameters to decide their suitability for publication.
- Articles not found suitable for publication are immediately returned.
- Articles found suitable are retained for publication in future issues and an acceptance letter is sent to the authors.
- However, acceptance does not guarantee immediate publication because we have a huge backlog of accepted articles.
- Should the authors wish to submit their articles to some other publication their articles can be returned on request.

Academic Guidance

I would like to suggest a point that I feel is important and missing in the magazine. I am a new member of *Science Reporter* and found it highly enriched with knowledge, but looking at today's context I think there is a need to provide knowledge of the universities and their details like fee structure and ways of admission. For instance, in a recent article on bio-plastics, a list of universities supporting biotechnology according to their ranking and details could have been provided so as to make the upcoming generation aware of more science related fields that are available.

Surbhi Gupta
Delhi

SCIENCE REPORTER
WISHES ITS READERS A VERY HAPPY AND PROSPEROUS
NEW YEAR 2008!

Pushing Ahead with Climate Control

The December 2007 climate change conference held at Bali in Indonesia seems to have ended on a positive note for developing countries after the Indian delegation's successful defence against any imposition of binding targets for reducing greenhouse gas emissions. Developing nations need not worry about meeting target cuts in greenhouse gas emissions at the cost of economic development.

The industrialized countries that are responsible for 70% of the pollution have been expected to cut their carbon footprint. But these countries have been insisting that after 2012 even developing countries such as India and China, where emissions are increasing, must also undertake emissions cuts. However, developing countries have been opposing such cuts because they believe that cutting down on emissions arising out of burning fossil fuels, would put on hold their economic growth. The demand has always been that the worst polluters be held more responsible. In some small measure this seems to have come to pass with the US moving away from its obstinate stand and even Australia reversing its stand. Hopefully, both countries would be expected to play along in the future too.

Yet another major success was making industrialized countries accept responsibility of funding and supporting transfer of cleaner technologies at subsidized costs to help reduce their carbon footprint. Smaller countries will also breathe easy with rich countries, for the time being, having agreed to pay poor countries to adapt to threats from climate change, such as increased floods and droughts.

Attended by delegates from over 180 nations and presided over by Indonesian environment minister, Rachmat Witoelar, the Bali meet was slated to be a precursor to launching negotiations for a post-2012 deal on carbon emission cuts after the Kyoto Protocol expires. The Kyoto Protocol calls on the 36 big emitters of greenhouse gas emissions to reduce their emissions by a fixed percentage by 2012. The Bali meet centred round finalizing a roadmap for a future international agreement on enhanced global action to fight climate change in the period after 2012, the year the first commitment period of the Kyoto Protocol expires.

Parties at the Bali meet had among their agenda the need to agree on the key areas which the new climate agreement should cover, such as mitigation (including avoiding deforestation, where industrialised nations pay rainforest-rich nations to protect their forests to offset greenhouse gas emissions), adaptation, technology and financing. After 14 days of intense negotiation, the Bali outcome suggests that the existing principles of the UN treaty would be adhered to and that developing countries can afford to push ahead with their economic growth story while at the same time employing cleaner technologies transferred to them by developed countries. Besides, developing economies get to set their own targets for bringing down carbon emissions. The final contours of the fresh agreement that comes into effect after 2012 would be thrashed out in the next meeting to be held in Copenhagen in 2009.

It was encouraging that the major players agreed to push ahead with a broader pact for the future despite their differences. This year's report from the Intergovernmental Panel on Climate Change (IPCC) has "made clear beyond doubt that climate change is a reality", which poses a serious threat to the future development of the world's economies, societies and ecosystems. According to the IPCC, if no action is taken on greenhouse gases, the earth's temperature could rise by 4.5°C or more. It is only right therefore that the nations of the world get together to thwart such eventualities.

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Printed and published by S.K. Rastogi on behalf of the National Institute of Science Communication And Information Resources (*NISCAIR*), CSIR, Dr K S Krishnan Marg, New Delhi-110 012 and printed at Shagun Offset Pvt. Ltd., B-3/16, Safdarjang Enclave, New Delhi

Science Reporter is published monthly by the National Institute of Science Communication And Information Resources (NISCAIR), CSIR, Dr K S Krishnan Marg, New Delhi-110 012. NISCAIR assumes no responsibility for statements and options advanced by the authors nor for any claims made in the advertisements published in *Science Reporter.*
Phones: Editorial: 91-011-25848702 *Sales/Subscription:* 91-011-25841647 *Advertisement:* 91-011-25843359
Fax: 91-011-25847062
Email: *Editorial:* sr@niscair.res.in; *Sales:* lkc@niscair.res.in
Website: http://www.niscair.res.in
Subscription: Inland: 1 yr: Rs 150/-; 2 yrs: Rs 280/-; 3 yrs: Rs 400/-; Foreign: 1 yr (Air Mail): US $50
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DEEPAK DASS

Call of the Mountains

Time passes slowly up here in the mountains,
We sit beside bridges and walk beside fountains,
Catch the wild fishes that float through the stream,
Time passes slowly when you're lost in a dream.

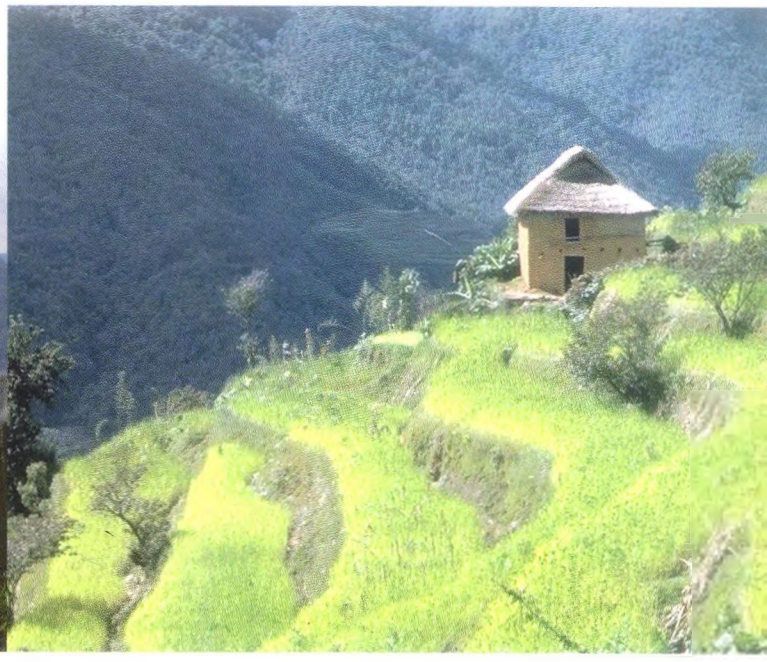
(Bob Dylan, "*New Morning*", 1970)

WHEN the mountains beckon its hard to hold back. And once in the midst of the enchanting snow-capped peaks its cruel to even think of going back. The cool fresh air, clean rippling streams, exhilarating walks and breathtaking views enchant one and all.

In fact, mountains have always held a fascination for humans. Journey across perilous heights and terrains in the ancient past came as a necessity for trade and conquest. Besides the obligations of commerce and invasion, mankind has forever been fascinated and daunted by the magnificence and risks of mountains. For some the passion for challenges and exploration urges them to scale the towering mountain peaks, for others the sight and sound of the serene alpine surroundings is a joyous way of getting close to nature. Whichever way, the *call*

A trip to the mountains can be enchanting. But if you do not respect the hardy environment at the high altitudes, you could be in for a tough time.

Glaciars in the mountains



of the mountains has always been alluring.

The grand Himalayas hold the most fabulous and astounding prospect for mountaineering and trekking. Himachal Pradesh, Garhwal and Kumaon regions, Ladakh and Sikkim have been the most sought after mountaineering destinations for travellers across the world. In India, mountaineering and trekking as a rewarding outdoor activity has come up in a big way, it's no longer regarded as a backpacking westerner's pursuit. Basic and advanced level training in mountaineering is imparted by quite a few mountaineering and adventure institutes situated in Darjeeling (*www.darjeelingnews.net*) in West Bengal, Uttarkashi (*www.nimindia.org*) in Uttaranchal, and Manali and Dharamshala in Himachal Pradesh.

But travelling to high altitudes to savour the spectacular splendour comes with inherent risks. It is important to understand these risks and respect them.

High Altitude

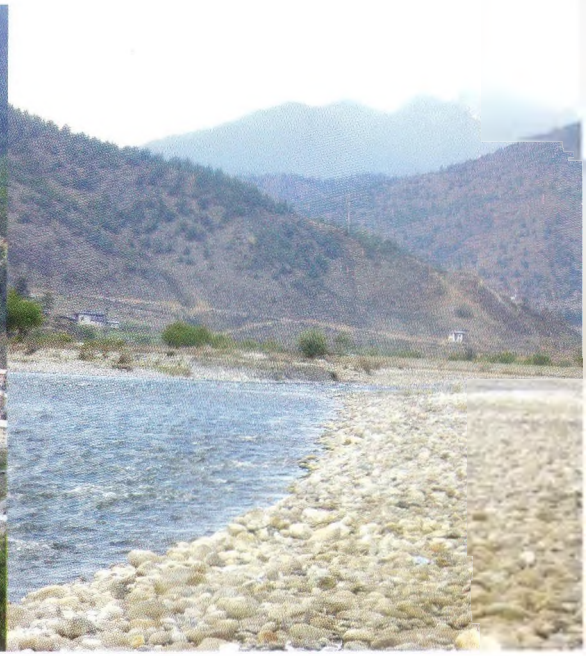
Altitude is by and large defined on the following scale:

- High Altitude:
  8,000 - 12,000 feet
  (2,438 - 3,658 meters)
- Very High Altitude:
  12,000 -18,000 feet
  (3,658 - 5,487 meters)
- Extremely High Altitude:
  18,000+ feet (5,500+ meters)

The major environmental conditions encountered at high altitude are low barometric pressure, rareness of oxygen, exceedingly low temperatures, high wind velocity, scanty vegetation, increased ultra-violet radiation and low humidity.

The concentration of oxygen at sea level is about 21% and the barometric pressure averages 760 mmHg. Therefore the individual pressure (partial pressure) exerted by oxygen is 21% of 760 mmHg, that is, 160 mmHg. As one ascends through the atmosphere, barometric pressure decreases (though the air still contains 21% oxygen) and thus every breath contains fewer and fewer molecules of oxygen. Further, oxygen transfer in the lungs depends on the partial pressure

The call of the mountains is ever so fascinating due to beautiful sceneries.



of oxygen (PO_2) in inhaled air. The turn of events diminishes the amount of oxygen available to the blood and tissues in the body.

Low temperature and increased wind velocity leads to a rapid fall in skin temperature. This effect is termed as "wind chill factor". Wind chill factor is of great importance on exposed skin surfaces such as the face, where frostbite may occur. Owing to the rarefied atmosphere at high altitude, radiation of the sun greatly increases.

Human Responses

Most human beings and mammals on the planet live at sea level or at low altitudes and their physiology is synchronised with the partial pressure of O_2 in the atmosphere and high barometric pressure. Elevations of 2700 m (9000 ft) above sea level and beyond are associated with physiological and sometimes pathological changes related to hypoxia (lack of oxygen). Hypoxia has been defined as conditions with lower than normal (*i.e.* sea level) oxygen availability. Several systems within the body, like cardiovascular, pulmonary, and endocrine react to the hypoxia related with high altitude.

The physiological responses of man to high altitude are complex and extensive. Of course they depend, among others, upon the severity and rate at which hypoxia is imposed. High altitude exposure has been an area of research for a considerable period of time.

For ages, mankind has experienced that breathing in high mountainous areas is taxing. This typically indicates that the lungs are having difficulty in supplying the body's demand for oxygen. Since the amount of oxygen required for activity is the same, the body tries to adjust to having less oxygen. Arterial oxygen saturation (SaO_2), the percentage of binding sites of haemoglobin molecules that are carrying oxygen, is decisive in determining the amount of oxygen obtainable for expending within the body. Within minutes of exposure to altitude SaO_2 begins to drop. After a stage of adjustments, the body will acclimatize and it can be anticipated that the SaO_2 will rise steadily.

Heart rate and blood pressure initially increase with exposure to altitude, then gradually return towards sea-level values as acclimatization progresses.

Ventilation or the volume of air breathed per minute interval increases even during rest and is considerably higher as compared to sea-level values. This response may be so as to reduce the partial pressure of carbon dioxide (PCO_2) in the alveoli, thereby allowing alveolar PO_2 to increase. As alveolar PCO_2 is reduced, carbonic acid in the blood is also reduced making the blood more alkaline. The kidneys respond by increasing bicarbonate excretion in order to return blood pH to near its normal value. The concentration of oxygen-carrying red blood cells is increased by the production of new red blood cells resulting in a hematocrit about 10 % or more higher than sea-level.

All the above physiological responses are normal as the body adjusts itself to the new environment.

(A) Himalayan Mountaineering Institute, Darjeeling.
(B) Pangong Tso, Ladakh at an altitude of 13,900 ft.
(C) Spituk Monastery situated at Leh (12,000 ft).
(D) Excursions to high altitude present the most breathtaking sights nature has to offer.
(E) Sherpa children, some high altitude communities like the Sherpas have been residing at high altitude for a long time, due to which they have undergone long-term physiological and biochemical changes that help them lead an active normal life at high altitude.
(F) The hardy yaks (*Bos grunniens*) grazing at an altitude of 14,500 ft; they have fully adapted to high altitude.
NB: *All photographs taken by the author*

Acclimatizing to High Altitude

Acclimatization is a reversible non-inheritable adjustment in the anatomy or physiology of an organism, which facilitates its survival in an alien environment. At high altitude, primarily the body tries to adjust to the decreased availability of oxygen. Given time, the body can adjust to the decrease in oxygen molecules at a particular altitude. Hence acclimatization is a series of built-in adjustment mechanisms that can optimize performance at higher altitude. Certain essential physiological changes during acclimatization process are as follows:

- The depth and frequency of respiration increases, this is known as hyperventilation.
- Pressure in pulmonary arteries increases, facilitating blood to go into regions of the lung, which are generally not used during breathing at sea level.
- More red blood cells are produced to increase the oxygen carrying capacity.
- The body produces more of certain enzymes that facilitate the release of oxygen from haemoglobin to the body tissues.
- There is increased urination.

There is great individual variation in the rate and degree of acclimatization. A number of scientific studies have surmised that there is not as much effect of age, gender, physical fitness, or previous altitude experience. Some people acclimatize to altitude quickly, while others cannot get above reasonably moderate heights. Individual variation in the process of acclimatization is still poorly understood, medically. Unfortunately, no way has been found to predict who is likely to acclimatize and who will fall short.

High Altitude Illnesses

High altitude poses the following challenges:

- decrease in the level of oxygen
- low barometric pressure
- decrease in temperature
- high wind speed
- difficult terrain
- increased degree of solar radiation
- low humidity

The illnesses developed in these adversities have a unique spectrum of manifestations.

***Acute Mountain* Sickness (AMS):** AMS is the most frequent and relatively less dangerous of the various illnesses caused by the hypoxia of high altitude. It is an assortment of symptoms that indicates an individual is not getting acclimatized to the high altitude. It is characterized by headache, fatigue, insomnia, dizziness, palpitations and nausea. Symptoms begin a few hours after ascent, mild AMS does not interfere with normal activity and symptoms generally subside within 2-4 days as the body acclimatizes. All of these symptoms may vary from mild to severe.

The occurrence of AMS is dependent upon the elevation, the rate of ascent, and individual susceptibility. The exact mechanisms of AMS are not completely understood, but the symptoms are thought to be due to mild swelling of brain tissue in response to the hypoxic stress. When trekking at high altitude, it is essential to communicate any symptoms of such illness immediately for the reason that it may escalate to more serious and life threatening maladies like High Altitude Pulmonary Edema (HAPE) and High Altitude Cerebral Edema (HACE).

***High Altitude Pulmonary Edema* (HAPE):** HAPE results from fluid buildup in the lungs. The fluid in the lungs prevents effective oxygen exchange. The blood vessels of the lungs are highly sensitive to insufficiency of oxygen, which causes them to constrict. Due to rise in hydrostatic pressure some fluid from the blood vessels leaks in to the alveoli.

Symptoms include breathlessness even at rest, "tightness in the chest," noticeable fatigue, a feeling of impending suffocation at night, weakness, and a persistent productive cough bringing up white, watery, or frothy fluid. In extreme cases hallucination is not uncommon; confusion and irrational behavior are signs that inadequate oxygen is reaching the brain. In cases of HAPE, immediate descent is an essential life-saving technique.

***High Altitude Cerebral Edema* (HACE):** HACE is a dangerous illness involving increased pressure on the brain. Fortunately incidence of HACE is rare. Symptoms are similar to that of AMS but of a greater severity, there is a characteristic loss of co-ordination (ataxia), hallucinations and decreasing levels of consciousness. The principal feature of HACE is noticeable change in ability to think coherently, manifesting as confusion and changes in behaviour. As in HAPE, taking the patient to lower altitude as quickly as possible has been a valuable protocol.

***Hypothermia*:** Hypothermia is characterised by a lowering of core body temperature from the normal value of 37^{0}C. The weather of high altitude areas is prone to sudden changes with storm, hail, blizzards and at snowbound high altitude regions there is every chance of falling into crevasses and icy river gorges. Hypothermia can be categorised as mild, moderate, and severe, depending on the fall in core temperature. The hypothermia could be due to freezing wind-exposure or cold-water immersion.

***Cold injury*:** Cold injury is a tissue trauma produced by exposure to freezing temperatures and windy environment. Extremities including hands, feet, nose and ears are somewhat less protected and thus more prone to cold injury on exposure to severe cold. The instantaneous response on exposure to severe cold is constriction of peripheral blood vessels (vasoconstriction), leading to reduction in blood flow, especially to the extremities. In the cold areas of high altitude the problem becomes more evident, since cold stress is coupled with hypoxia.

Among the various types of cold injuries chilblain is the least severe while frostbite is the most severe form. In chilblain the fingers and toes begin to itch, turn red and become very painful within a couple of days. Sometimes, chilblains end in blister and ulceration. The chief reason is defective circulation of the extremities. The most serious and dangerous effect of severe cold is frostbite. Frostbite is caused by freezing of the skin and subcutaneous tissues of variable depth, due to ice crystal formation, which may lead to tissue loss.

The efficacy of drug prophylaxis and treatment in these high altitude maladies is beyond the scope of this article.

Mountain Dwellers

The major regions of the world where large communities exist at high altitude on a permanent basis are the Andes, Tibetan plateau, and the Himalayas. It has been recognized that some ethnic populations who have been residing for a very long time may have undergone some lasting physiological and biochemical adjustments to this extreme environment. The prominent ones among them are the Sherpas, residents of the Himalayas, and the Quechua Indians of the Peruvian Andes.

A great diversity of animals have also successfully adapted to high altitude. Some of the well-known mammalian species are the yak, llama, alpaca, ibex, bharal, snow leopard, etc. The yak of Tibet and the Himalayas and the llama of the high Andes have lived with humans as domesticated animals. These animals have thrived well in an environment that would otherwise be considered uninhabitable for other species. Some animals like the yak and llama have become adapted in the rightful sense of the word; its adaptive features are heritable unlike mere acclimatization.

Staying Healthy on Top

Staying healthy at high altitudes acquires importance if one has to really soak in the beauty of the sylvan surroundings of the mountainous peaks. But again, staying healthy requires careful adherence to certain key parameters. Never take your body for granted. Give it time to settle down.

In India, mountaineering and trekking as a rewarding outdoor activity has come up in a big way, it's no longer regarded as a backpacking westerner's pursuit.

So, here a few tips that would help you stay in top physical condition the next time you plan to take a trip to the high altitudes.

1. Properly acclimatize through gradual and slow rate of ascent.
2. Take adequate rest during the first few days of induction to high altitude and do not overexert.
3. Avoid dehydration by constantly drinking water of lukewarm temperature.
4. Do not disregard initial symptoms of any illness, inform medical support immediately.
5. Carry nutritious snacks that contain sugar and other carbohydrates for instant energy sources. Consume small amount regularly so as to maintain a steady flow of body fuel all day. Avoid alcoholic beverages and smoking.
6. Clothing should be wind-proof, dry, and well insulated, with adjustable ventilation. Dress in layers so that clothing may be adjusted for overcooling, overheating, perspiration and external moisture. Put on raingear before getting wet. Sweat from exertion must be wiped dry.
7. Cover exposed parts sufficiently to avoid cold injury. Do not touch metal with bare hands.
8. Use suitable snow goggles while in snow-bound areas.
9. Trekking in a group can be reassuring and can increase the chances of survival in the event of distress.
10. It's prudent to rule out any severe medical conditions before embarking on a sojourn/trekking to high altitude.

The call of the mountains is ever so fascinating. Enthusiasts planning a trip to the high altitudes must be aware of the symptoms of altitude illnesses to prevent any likelihood of falling victim to such illnesses.

Shri Deepak Dass is with the Defence Institute of Physiology and Allied Sciences (DIPAS), Lucknow Road, Timarpur, Delhi – 110054; Email: dassdeepak69@yahoo.com

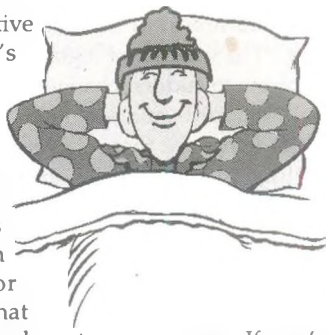
USHA PANJWANI

Sleeping High up in the Mountains

'....And I have promises to keep, and miles to go before I sleep.' The celebrated mountaineer, Willi Unsoeld, quoted these famous lines from a poem by Robert Frost when he prepared to descend from Mt Everest after a successful ascent along with Tom Horbein in the year 1963. By all accounts he must have slept like a log after his descent. But how sound was his sleep on the high altitudes of the Himalayas?

High altitude mountaineers and even tourists often complain of sleeping disturbances at high altitudes. What is the disruptive influence of high altitude on sleep? Let's first get to know what sleep is.

Sleep is a state of consciousness, other states of consciousness being wakefulness, meditation, and hypnosis. It is also described as a state of unconsciousness that is reversible. Why is it that we spend a third of our life in slumber? Out of 24 hours, an adult human on an average spends eight hours sleeping. We do have some but not all the answers.



Sleep is a physical restorative process; after a good night's sleep, we are ready to face a new day. It is also essential for mental function; it restores the neurons from exhaustive to rested and active state. So, sleep is essential to restore brain function. It is needed for consolidation of memory, that is, conversion of short term to long term memory. If you're told a friend's name that you would like to remember for months or years, all it takes is normal dream sleep, which converts brain (neuronal) circuits into connections between neurons of a more lasting nature. During sleep, hormones essential for normal physiological functions (like growth hormone) are also secreted.

If an animal is deprived of sleep, it gets irritable, loses appetite and all interest in its surrounding, and eventually dies. Humans deprived of sleep have difficulty in attention, concentration, vigilance, and mathematical ability; in short any mental function.

Human sleep is categorized into non-rapid eye movement (NREM) or slow wave sleep (SWS) and rapid eye movement (REM) sleep. NREM sleep is divided into four stages: S1, S2, S3 and S4. We enter sleep with stage S1 when the brain activity (electroencephalogram or EEG) shows a transition from wakefulness. S1 and S2 are 'light' sleep stages.

High altitude regions pose the combined hazards of hypobaric hypoxia and hypocapnea.

S3 and S4 are 'deep' sleep stages. REM is the stage when you start dreaming. It constitutes 20-25% of total sleep, and is characterized by rapid eye movement, loss of muscle tone and EEG similar to wakefulness.

Sleep changes according to a particular pattern from infancy to adult life to old age. A newborn has 50% REM but as he grows into adulthood, REM reduces. Deep sleep stages S3 and S4 reduce in old age, as does the total sleep time.

Sleeping on the Top

High altitudes have always held a fascination for mountaineers. Only a mountaineer knows the thrill, the agony and ecstasy of conquering a peak. In recent years, these regions have also developed as major tourist attractions worldwide, offering added attraction of winter sports like skiing and mountain climbing. In India, Leh and Ladakh, earlier considered inhospitable, are now popular holiday destinations. Some of these locations in the Eastern and Western Himalayas also form border areas with our neighboring countries and are significant for the operational requirements of our Defence forces.

It is in this context that it is important for us to understand physiological functions at high altitude. High altitude regions pose the combined hazards of hypobaric hypoxia and hypocapnea (low oxygen and carbon dioxide tension in ambient air), often accompanied by severe cold and ultraviolet physiological responses in all body functions including sleep function which ultimately help in acclimatization, that is, adjustment of our body processes and appropriate responsiveness to such an environment.

What happens to the sleep pattern while you are at high altitudes? On ascent to high altitude, sleep pattern is commonly altered, although the extent of disturbance may vary from person to person. The common complaint is that one cannot get sleep for a long period or one wakes frequently and does not awake refreshed in the morning.

The first study on sleep at high altitude in Indian lowlanders was carried out by scientists of the Defence Institute of Physiology and Allied Sciences (DIPAS) in 1986. Subsequent scientific studies were carried out again in two phases. In phase 1 the effect of induction to 3500 m in the Eastern Himalayas was studied. Phase 2 evaluated the effect of induction to 4300 m in the Eastern Himalayas, after acclimatization at 3000 m for one week.

The study elicited an increase in time taken to fall asleep, difficulty in staying asleep, poor subjective quality of sleep ranked on a scale of 1-10 and greater extent to which disturbances like headache and nausea interfered with sleep. There was sleep fragmentation at high altitude, that is, greater number of awakenings. The total time spent in sleep was not altered much. There was a reduction in deep sleep stages, that is, S3 and S4 of NREM sleep, while light sleep was increased. REM stage or dream sleep was also reduced.

During sleep at high altitude, there are also changes in the pattern of respiration. There may be periods of apnea, a temporary stoppage of airflow and hypopnea, a reduction in airflow. At altitudes above 3500 m, periodic breathing is observed in some sojourners. Periodic breathing refers to a phenomenon that occurs during hypoxic sleep wherein rapid shallow breathing (hyperventilation) is followed by stoppage of respiration (apnea), which is followed again by hyperventilation; this cycle continues for variable periods during the night.

Periodic breathing may or may not wake up a person sleeping at high altitude; it has been often observed during light sleep and the individual continues to sleep in the same stage. All sojourners at high altitude may not encounter periodic breathing. In DIPAS studies at 4300 m, periodic breathing was observed only in 40% of the participants during light sleep. Periodic breathing is not likely to cause reduction in oxygen saturation of the body while breathing; some researchers are of the view that it may be beneficial in improving the oxygenation.

Remedial Measures

Sleep disturbance at high altitude sometimes contributes to a temporary impairment in cognitive function. A soldier with sleep disturbance may have difficulty in attention, concentration, vigilance and working memory. Often mental activities that are mechanical in nature, such as tabulating a set of data, can be accomplished whereas activities that require problem solving and initiative could be affected. It is important to remember that these changes are temporary. After a few days or one to two weeks, acclimatization occurs, our body processes adjust and respond appropriately and mental performance may not be seriously affected. The changes are reversible when we come back to sea level. A soldier may have to be deprived of sleep during war, conflict or other operational requirement. It is a challenge to help him perform properly in such situations following sleep deprivation.

The changes in sleep pattern are also a part of acclimatization process, which helps our body adjust to low oxygen (hypoxia). At high altitude, simple remedial measures may help in keeping almost normal sleep. Selective inhibition of renal carbolic anhydrase by Benzolamide has been shown to reduce periodic breathing and acute mountain sickness as well, thus improving sleep at high altitudes.

Benzodiapines (Alprazolam, Diazepam, Clobazam, etc), barbiturates and tricyclic and monoamine oxidase inhibitors are commonly used to improve quality of sleep in terms of hastening sleep onset, decreasing nocturnal awakening and increasing NREM sleep; thereby imparting a feel of deep, refreshing sleep. Oral slow-release Theophylline (a phosphodiesterase inhibitor) also efficiently improves sleep quality. Besides, nocturnal oxygen enrichment of the room at high altitude area will also be helpful in maintaining normal sleep.

Last but not the least, our ancient wisdom of yoga and meditation and some relaxing exercises are effective in enhancing the quality of high altitude sleep. These techniques are also of value in enhancing mental functions following sleep deprivation.

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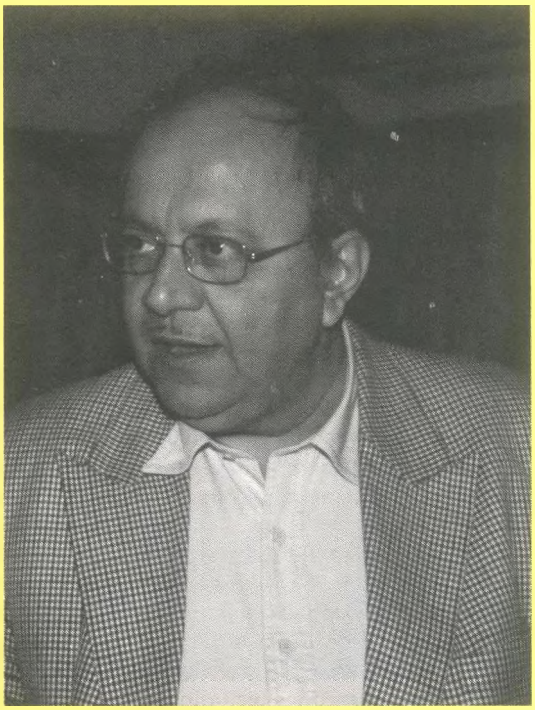
Prof. Samir K. Brahmachari takes over as Director General, CSIR

PROF. Samir K. Brahmachari, until now Director of the Institute of Genomics & Integrative Biology (IGIB), Delhi, has taken over as Director-General of the Council of Scientific & Industrial Research (CSIR). Simultaneously, he also takes up the charge of Secretary, Department of Scientific and Industrial Research (DSIR), Government of India.



A PhD in Molecular Biophysics from the Indian Institute of Science, Bangalore, he served as Professor of Molecular Biophysics and Genetic Engineering at the IISc. After taking over as the Director of the relatively unknown Centre for Biochemical Technology (CBT), CSIR, Prof. Brahmachari's initiatives saw the Institute undergoing major transformations to emerge as a leading Institute of Genomics & Integrative Biology (IGIB). During his stint at IGIB, Prof. Brahmachari for the first time conceptualized and implemented *Genomed*, a first-of-its-kind knowledge alliance in India between a government Institute and a pharmaceutical company—Nicholas Piramal India Limited—dedicated to the study and advancement of genomics, pharmacogenomics and bioinformatics.

Prof. Brahmachari also conceptualized the creation of TCGA, "The Centre for Genomic Application". It is a collaborative R&D project between The Chatterjee Group and IGIB/CSIR/DST that is used as a shared resource for all the research centers in the country, be it public or private. TCGA is a trendsetter in this direction, where a world-class high throughput facility/infrastructure required to harness the knowledge coming out of Human Genome research is established jointly by industry and an Institute.

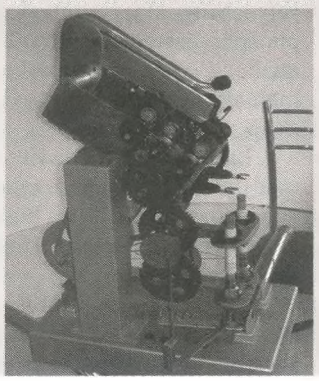
Prof. Brahmachari's work in demonstrating the structural flexibility of DNA is well known. He has also made major contributions in molecular analysis of genetic disorders associated with trinucleotide amplification and repetitive sequence instability. Taking advantage of the genetic diversity of the Indian population, he has pioneered functional genomics initiative in India and led the Indian Genome Variation Consortium project towards development of predictive markers for complex disorders. He also coordinated a national network project in *In Silico* Biology for drug target development.

Prof. Brahmachari has also been involved in issues relating to Genomics Research and Human Rights. As an advisor to the Human Rights High Commission, he has also addressed issues of unethical exploitation of genetic resources of the Third World and has championed the concept of rights of patients in benefit sharing in the development of genomic medicines.

A Fellow of the Indian National Science Academy (INSA) and the Indian Academy of Sciences (IAS), Prof. Brahmachari was elected a member of the Human Genome Organization, 1991 and to the HUGO Council in 2004. Prof. Brahmachari is the recipient of the INSA Young Scientists Award, 1979; Kani Medal (National Cancer Research Centre, Japan), 1981; Shanti Swarup Bhatnagar Award (CSIR) 1990; FICCI Award (1999); Millennium Medal (Indian Science Congress) 2000; Ranbaxy Research Award (2001); Prof. B.R. Ambedkar Centenary Award for Excellence in Biomedical Research (ICMR) 2005; J.C. Bose Medal (INSA) 2007; and H. K. Firodia Awards For Excellence In Science and Technology (2007).

Gandhiji's Charkha Emits Light

IT once stood as a symbol of economic self-reliance in pre-independence India, but the humble spinning wheel made famous by none other than Mahatma Gandhi, the Father of the Nation, could now power a different revolution – producing cheap electricity for millions of poor households. Aptly named E-Charkha, the invention comes at a time when the nation is debating the pros and cons of nuclear energy.



The device is the brainchild of the Chairman of the Khadi and Village Industries Commission (KVIC), Kumudben Joshi. The twin-spindle E-Charkha is now being showcased at the KVIC headquarters at Vile Parle, Mumbai. "It can light up bulbs, operate radio and even charge a cell-phone," says S.K. Sinha, Director (Khadi Co-ordination) with the KVIC.

The principle is simple – the energy produced from the rotation is stored in a battery, which can be used later – quite similar to the operation of a dynamo, which too produces power. In fact, Sinha reveals that the brilliant idea came from a Bangalore-based entrepreneur R.S. Hiremath, who

An Unusual Comet

Comets have been feared throughout much of human history, and even today their goings and comings receive great attention not only of astronomers but also the public at large. The name comet comes from the Greek word *kome*, which means "hair of the head," that refers to the "luminous tail of a comet." In fact, it is the tail of a comet that becomes visible as the comet nears the Sun in its orbit and which distinguishes it from other celestial bodies. But Comet Holmes, which shot into view in late October this year in the constellation of Perseus, is a clear exception – it does not sport the characteristic tail. To the naked eye, it looks like a modestly bright, fuzzy star.

Comet Holmes has turned out to be exceptional in another respect – it is the first comet to show a sudden brightening by a factor of over a million in just a matter of hours, as it belched out an enormous puff of fine dust, lit up by sunlight. Between 23 and 24 October 2007, the comet changed from being a magnitude-17 object, visible only through large telescopes, to become a magnitude-2.5 object, making it similar in brightness to the stars that make up the famous Big Dipper – visible without optical aid. The dust cloud has been expanding, enthralling astronomers with a sight unlike anything they have seen. Astronomers could not explain what caused the comet to brighten up – especially since it was at that time quite far away from the Sun's energetic influence. One possibility is that the comet was hit by a meteoroid. More probably, there has been a build-up of gas under part of the surface that catastrophically ruptured the surface leading to the dramatic increase in brightness.

Holmes is actually an old comet – a periodic comet. It was first seen on 6 November 1892 by British observer Edwin Holmes while he was conducting regular observations of the Andromeda Galaxy (M31). The orbital period of Comet Holmes is about six years, putting it in the class of Jupiter Family Comets whose orbits are strongly influenced by Jupiter. These objects orbit the Sun beyond Neptune, in a region known as the Kuiper Belt. Holmes probably was deflected into its present orbit within the last few thousand years. Astronomers believe that in another few thousand years it is likely either to hit the Sun or a planet, be ejected from the Solar System, or simply die by running out of gas.

Since its discovery in 1892 the Comet Holmes has made 16 circuits around the Sun and should have fizzled out a long time ago, as it lost mass every time it went round the Sun. During its closest approach to the Sun in May this year it passed by at a distance of some 307 million kilometres. At present, the comet is moving away from the Sun and is somewhere midway between the orbits of Mars and Jupiter.

But why does Comet Holmes not sport a tail? Like any good comet, Holmes' tail would tend to point away from the Sun, pushed by the solar wind. That direction in this case happens to be nearly along our line-of-sight behind the comet, which makes its tail very difficult to see. From Earth, only the fuzzy coma of the comet is visible as a halo around the bright nucleus, which shines by reflecting sunlight.

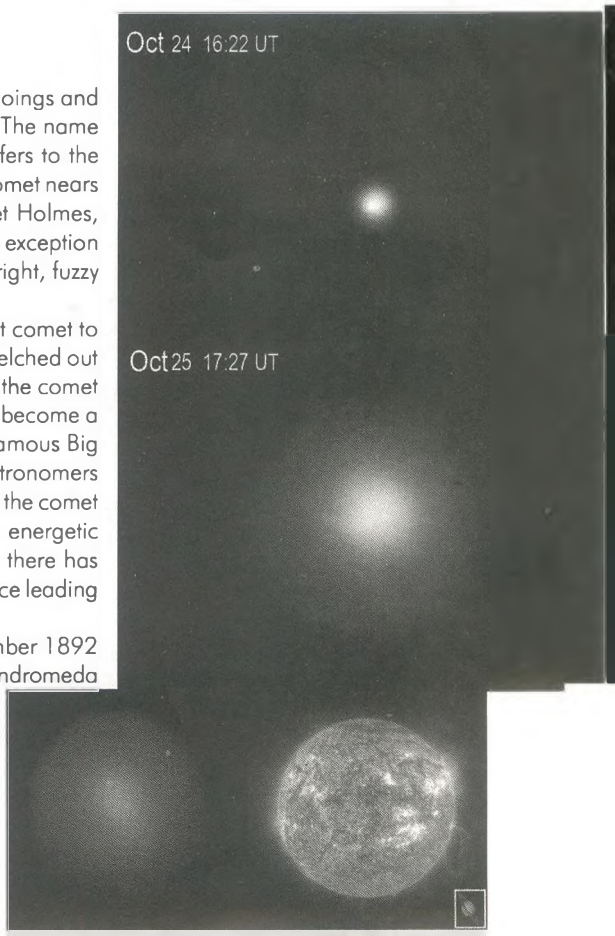


Image of Comet Holmes taken on 24 and 25 October showing its spectacular increase in size (above). The Sun and planet Saturn are shown at the same scale for comparison (below).

(Sun and Saturn images courtesy of NASA's *SOHO* and *Voyager* projects)

Comet Holmes came up with yet another surprise on 6 November 2007 when images of the comet taken with the 3.6-metre Canada-France-Hawaii telescope on Mauna Kea showed its coma to have expanded to over 1.4 million kilometres in diameter, which made it larger than the Sun! But unlike the Sun, which is massive, the size of the comet is deceptive, as most of the coma is highly tenuous – made of mostly fine dust and gas ejected from the nucleus with relatively negligible mass.

Contributed by Shri Biman Basu. Address: C-203, Hindon Apartments, 25, Vasundhara Enclave, Delhi-110096; Email: bimanbasu@gmail.com

is Managing Director of Flexitron, engaged in promoting non-renewable energy.

The E-Charkha weighs twenty-and-a-half-kg. However, efforts are on to reduce the weight. As regards the cost, he said, as of now it would be available at a price of nearly Rs 3,200, however, when it is produced in bulk, the price would come down by15 to 20 per cent. It would be available in Khadi showrooms across the country.

The E-Charkha has a maintenance-free lead acid battery fixed at the bottom, which functions as an inverter. Spinning the Charkha for about two hours will give back-up power for about 6–7 hours of basic lighting and playing radio. In this system, a battery is charged when the Charkha is being used which can store and supply power to light up a small LED based 'home-light'. The LED light has an extremely long life of at least 35 years. The generator of the E-Charkha is also of the latest design and has virtually the same life of almost 35 years. All components have been chosen after a worldwide search so that the end user has a reliable, foolproof, weatherproof and rugged product, which can be enjoyed for many years.

The concept of the E-Charkha stems from the urge to provide both income, in the form of yarn, and electricity to the poorest masses in remote villages.

Contributed by Shri Mrityunjay Bose who works as the Mumbai-based Principal Correspondent of *The Maharashtra Herald*, a Pune-based daily. Address: 102, A-Wing, VK Tower, Evershine City, Vasai (East), Thane District, Maharashtra – 401208

Why do Bats Hang Upside-down?

BATS flying around can be really scary. But bats hanging upside-down are even scarier. How and why do they hang upside-down? This question has long puzzled scientists. Obviously, bats had to reduce their bone mass and thereby their body mass, as an adaptation for efficient flight. A usual explanation is that the upside-down posture of bats might be the result of natural selection to ease their launch into flight by simply dropping and gliding from their roosting sites such as caves and trees. Why do birds perch upright then?

In 1977, Howell and Pylka came up with the explanation that the leg bones of bats are light and slender, which enhances their ability to fly. The femora (i.e. thigh bones) of bats are very delicately built making it difficult for them to withstand the compression stress borne by their body weight while in upright position. This makes bats unlikely to perch in a way that birds can. Is it convincing enough? Well, not yet.

Bats actually have specialized tendons that hold their toes in place, ensuring a locking mechanism in the hind legs that allows them to hang from their feet or even from one foot, with less energy than they would by perching. How? The moment a bat hangs itself from a ceiling or a branch of a tree, its feet go into auto-lock weighed down by body weight plus gravitational force. Since the bats' feet lock by themselves, there is no need for them to have an extra hold on. This way, bats enjoy sleeping while hanging without any fear of falling.

Indeed, such strong 'tendon locks' allow bats to remain hanging during hibernation and even when they are dead. Hibernation is nothing but a form of long-sleep opted by bats during cold weather that reduces feeding opportunities. Not all bats do this, but only some Neotropical (New World) bat species hibernate.

Conceivably, bats have evolved necessary adaptations for their upside-down life. A remarkable one is that their hind legs are attached backward. In other words, hind limbs have rotated 180° so that the knees face backward. This rotation of the joint aids in the bat's ability to navigate in flight and eases land and hanging upside-down. When bats are ready to set out flying, they just need to flex their muscles in order to let go of. Unlike birds, bats do not need to invest any energy in takeoff, just unlock themselves from their roosts and drop into flight.

But try hanging upside-down and you find you cannot do it for a long time because the blood rushes to the head. However, in the case of bats, they have special valves in their veins that ensure smooth flow of the blood rushing towards the head when inverted. There could be several reasons why the upside-down posture has to be an evolutionarily derived one in bats. Firstly, by doing so, they are able to take advantage of roosting sites that other animals don't use, such as ceilings of caves and attics, which ensures them safety from predators. Also such shelters are of considerable use to keep them away from extreme hot or cold weather.

Contributed by Dr. N. Singaravelan who works at the Institute of Evolution, University of Haifa, Mount Carmel 31905, Israel. Address: S/o Mr. D. Natarajan (Rtd. Teacher), 3/60, Old Post Office street, Kali (post), Mayiladuthurai (Taluk), Nagai District, Tamil Nadu-609811

News Briefs

■ Adaptive changes in a human gene involved in speech and language processing were shared by our closest extinct relatives, the Neanderthals, suggests a study. The gene in question, known as FOXP2, is the only one known to date to play a role in speech and language. Previous analyses indicated that a very recent rise in the human FOXP2 variant had occurred as a result of strong selection, less than 200,000 years ago. The current results show that the Neanderthals carried a FOXP2 protein that was identical to that of present-day humans in the only two positions that differ between humans and chimpanzees.

■ A team of scientists at the University of Warwick in England studying the development of motility in frogs found that a certain ectoenzyme (a cell-surface protein) injected into a tadpole embryo triggered the development of tissues that eventually form eyes. Through many rounds of analysis, both by amplifying and decreasing the levels of certain chemicals as well as knocking out the function of certain genes that code for eye development regulating proteins, the scientists determined that E-NTPDase2 was the only ectoenzyme that could drive eye development.

■ A smog-filled sky can make it hard to breathe, but air pollution in the home may also be hard on people with lung disease, researchers have found. A number of factors, including outdoor air pollution, can affect indoor air quality. In general, homes had high levels of particulate matter — the fine airborne particles that constitute pollution. Smokers' homes had especially high concentrations. The air quality can be very much improved by stopping smoking in the home.

■ Electron microscope video and computer simulations show that "shrink-wrapping" is the birth secret of buckyballs — hollow spheres of carbon no wider than a strand of DNA. Heat distorts the sheets, shrink wrapping them into ever-smaller shapes. Thus, buckyballs start life as distorted, unstable sheets of graphite, shedding loosely connected threads and chains until only the perfectly spherical buckyballs remain.

■ According to British and Spanish scientists, cold spot in the oldest radiation in the universe could be the first sign of a cosmic glitch that might have originated shortly after the Big Bang. They think the spot, detected on satellite maps of microwave radiation, might be a cosmic defect or texture, a holdover from the universe's infancy. But this theory needs confirmation. If the cold spot is indeed proven to be a texture, it will completely change the view of how the universe evolved following the Big Bang.

■ Welsh scientists analyzing a clamshell from the North Atlantic off the coast of Iceland determined it was the oldest living animal in recorded history. The ocean quahog, nicknamed Ming, was determined to be 405 years old when it died. Scientists are able to determine the age of a clam by counting the growth rings in its shell, much like the rings of a tree.

■ Images taken by a camera onboard the NASA Cassini spacecraft revealed a series of eight propeller-shaped "wakes" in a thin belt of the outermost "A" ring, indicating the presence of corresponding moonlets. The scientists calculated that there are likely thousands of moonlets ranging in size from semi-trailers to sports arenas embedded in the "A" ring's thin moonlet belt that circles the planet. This is the first evidence of a moonlet belt in any of Saturn's rings.

KANTHIMATHI KANNAN & ANAR SHUKLA

Breathing Easy?

In a nationwide assessment of science concepts conducted by Educational Initiatives in August 2007, students were found to have several misconceptions about the process of breathing.

PHOTOSYNTHESIS (prepara tion of food), breathing and respiration are concepts that are learnt by students at a very early age. And yet they seem to get confused between these concepts and erroneously equate photosynthesis and breathing, and breathing and respiration.

Often students think that any process concerned with air, oxygen or carbon dioxide going in and out of organisms constitutes breathing. Respiration is perceived as synonymous with breathing. While photosynthesis is thought of as respiration in plants, respiration is believed to be an animal process.

The common view is that animals breathe in oxygen and breathe out carbon dioxide, whereas plants breathe in carbon dioxide and breathe out oxygen. Many children believe that the exchange of gases in plants is purposeful and beneficial to the humans through the oxygen it produces.

Why is it important to address these misconceptions? Why do these misconceptions occur? What are children's ideas about breathing? And what are the implications for teaching? We at Educational Initiatives tried to explore along these lines.

Educational Initiatives

Educational Initiatives (EI), www.ei-india.com, is an organisation run by a group of IIM-A alumni. Its mission is to bring about a significant improvement in the quality of student learning through research-based means with a special focus on assessment. It tries to accurately measure how well children are learning so that this can meaningfully serve as feedback on how our education system is doing as a whole. EI is also committed to doing concrete work on actually improving the quality of school education. Its efforts are focused on both private, English-medium schools and government-run schools. EI is working with the World Bank with rural schools in Andhra Pradesh, with UNICEF in 13 states of India, and also with municipal schools of 30 towns of 5 states, apart from over 1000 Private English-medium schools across the country.

There are various kinds of research projects running at EI, ranging from understanding how students of municipal schools of different states are learning to knowing how students of the top schools in the metro cities are learning, from assessing the reading levels of students in the municipal schools to understanding how students think. However, all the projects are still aligned to the core vision of the company, 'A world where children everywhere are LEARNING with UNDERSTANDING.'

People having good subject knowledge and an inclination and passion for working in the field of education are always encouraged to apply at EI. For more information about various projects and activities in which EI is involved, please visit www.ei-india.com. You can even write at info@ei-india.com.

SLIMS-2006

In 2006, a large-scale research study called Student Learning in the Metros (SLIMS) was conducted by EI and Wipro Applying Thought in Schools. About 32,000 students from about 140 of India's top schools in Mumbai, Delhi, Bangalore, Chennai and Kolkata were tested on their conceptual skills in English, Maths and Science. The study suggests that the problems of teaching and learning not being that effective may not be limited to government-run schools but probably prevail in leading schools of the country. The 2006 study showed that Indian students performed clearly below international levels in Maths and Science.

A number of misconceptions surfaced when the data from SLIMS-2006 was analysed. A need to further investigate these misconceptions and get deeper insights into the child's mind arose. EI-Wipro Applying Thought in Schools decided to conduct a follow up study called "How do our children think?" – A video series on the student misconceptions.

As a part of this series a special team of interviewers and videographers travelled to 28 schools (of the 142 that participated in the SLIMS 2006) across the metros and interviewed over 2500 students on over 30 questions.

About 100 hours of video recordings show that students have several wrong notions about basic concepts like measurement, fractions, classification of animals and plants, photosynthesis etc. Students tend to build several models based on what seems logically correct to them. This leads to various misconceptions.

Importance of Addressing Misconceptions

Photosynthesis is a concept that is central to the understanding of differences between plants and animals. Similarly breathing is used to differentiate between living things and non-living things. Respiration holds the key to the idea of energy for all living processes to take place. All these concepts need to be studied with their uniqueness as well as their inter linkages to comprehend the entire gamut of living beings.

One of the probable solutions is to use the 'Student Interview Approach' after the students answer a test/question.

Children's Ideas About Breathing

To investigate in detail whether students had a superficial or an in-depth understanding of respiration, we asked two questions. The set of questions given below were administered to all the students from grades 5 to 9. (44,500 students appeared in ASSET in August 2007)

About ASSET

ASSET is a diagnostic test conducted by EI on over 2 lakh Indian students since 2001. Our experience of assessing kids over the last 6 years through ASSET and other studies have repeatedly shown us that children even in the best schools in India aren't learning as much as they should.

The first question aimed to test whether children were able to distinguish between respiration, photosynthesis and a process of combustion such as 'burning of dry leaves'.

It's very important to understand how students think. Assessment, whether it be before teaching a particular concept or after teaching it, is as important as the content of the concept being taught.

Assessment should be used as a tool not just to know what students have learned but also to understand the way students learn.

Question 1

Which of the following are examples of respiration?

1. Humans use oxygen and release carbon dioxide.
2. Plants use carbon dioxide and release oxygen.
3. Burning dry leaves uses oxygen and releases carbon dioxide.

A. only 1 B. only 2 C. only 1 and 2 D. 1, 2 and 3

(Option A is the correct answer. But most students selected Option C, which probably shows a misconception)

Almost 22,000 students across classes believe that *plants using carbon dioxide and releasing oxygen is due to the process of respiration.* The question shows that they have a very superficial understanding of respiration – for them it is just a label for gas exchange. In fact, an increasing number of students in higher classes actually think that combustion and respiration are the same process!

Question 2

Which of the following statements about plants is true?

A. Plants take in only oxygen during the day

B. Plants take in oxygen only during the night

C. Plants take in only carbon dioxide during the day

D. Plants take in oxygen both during the day and night

(Option D is the correct answer. But most students selected Option C, which probably shows a misconception.)

The second question aimed to test whether children understand that respiration is a vital process for plants just as it is for other living organisms, and is a continuous process.

The analysis from this question shows that this superficial understanding of respiration leads almost 40% of them to choose the wrong answer. The crucial point is that they do not realise that respiration has to be a continuous process in all organisms because energy demand is continuous.

Also, the fact that almost 12,000 students have chosen the option, *'Plants take in oxygen only during the night'*, shows evidence to a clear cut misconception about the need for oxygen in plants.

That most students do not have much of clarity regarding the process of respiration is evident from the analysis. An overwhelming number of Grade 4 students believed that 'making of food' and breathing were one and the same. We further investigated this question by including it in SLIMS - 2006 (a nation-wide study conducted in the top schools of country).

The results of this study were similar to those in ASSET and it becomes increasingly important to understand the underlying causes of these common misconceptions. Two hundred and fifty (250) students across grades 4 and 6 were shown the same questions and asked to select their options. This time the students were asked to give reasons for their selections. These interactions were video recorded and further analysed by experts. It was found that students had several misconceptions regarding breathing and photosynthesis.

The most interesting finding during these interviews was that students who selected the correct answer also seemed to think that plants take in ONLY carbon dioxide during the day.

The transcripts below are an example of how children think. Responses were collected across metros and some of the common misconceptions have been highlighted below.

Class	**A**. Plants take in only oxygen during the day	**B.** Plants take in only oxygen during night	**C.** Plants take in only carbon di oxide during the day	**D.** Plants take in oxygen both during day and night
Class 5	9.9%	23.8%	43.5%	21.0%
Class 6	10.7%	25.7%	42.4%	19.7%
Class 7	8.0%	27.7%	45.8%	17.8%
Class 8	8.6%	30.5%	42.0%	18.4%
Class 9	8.9%	29.9%	39.5%	21.0%

Interviewer: How many feel that the answer is 'making of food'?

(Approximately 10 students raised their hands)

Interviewer: How many feel that the answer is 'breathing'?

(Almost 30 raised their hands and for the other options no one raised their hand)

Students think plants breathe in CO_2 and give out O_2

Interviewer: Why is the answer 'breathing'?

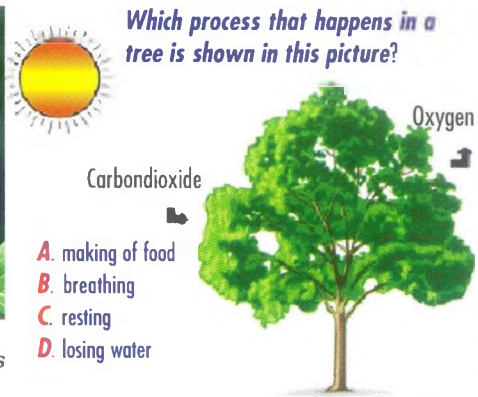
Student: Breathing because CO_2 is taken in and O_2 is given out.

Interviewer: Do we breathe the same way?

Student: No, we breathe in O_2 and give out CO_2 and plants are different.

Interviewer: Who agrees with him that the plants breathe in CO_2 and give out O_2?

(Almost everyone agreed)



Students believe that it's for us that plants produce oxygen

Interviewer: Why do we take in O_2 and give out CO_2?
Student: Nature has made it that way. Plants give us oxygen and we use that O_2.
Interviewer: Why do we need O_2 for our body?
Student: To maintain our body.
Interviewer: Do plants not need to maintain their bodies?
Student: Plants use CO_2 to maintain their bodies.

Students think that we need oxygen for digestion

Interviewer: Have you heard of respiration?
(Almost all the students had heard of it and one of them answered correctly that taking in O_2 and giving out CO_2 was respiration)
Interviewer: Why do we need oxygen?
Student: Respiration is where the food reacts with oxygen and gives out energy and carbon dioxide.
Student: We need oxygen for digestion.

Students think that photosynthesis and breathing are the same in plants

Interviewer: Is respiration the same as breathing?
(Almost all the students felt that respiration and breathing were identical)
Interviewer: Is the plant undergoing respiration?
Student: Yes, because for plants photosynthesis is like breathing and I think that both the answers 'making of food' and 'breathing' are correct.
Student: Breathing and photosynthesis are the same but the Sun being there makes it photosynthesis.

Students think that plants cannot take in both oxygen and carbon dioxide together

Interviewer: But all of you just now said that respiration meant taking in O_2 and giving out CO_2, so how is respiration the answer to the question?
Student: Plants use CO_2 and not O_2 and for plants the gases are different.
Student: Plants have a different method for respiration because they use CO_2 and give out O_2.
Student: Plants cannot take in O_2; they can only take CO_2. There is something in plants that prevents them from taking O_2.

One of the interesting conclusions that we got from the Student Interviews was 'Do not stop the questioning once the correct answer is reached. Go deeper and probe further. There are a number of layers left to unravel'.

Reasons for Misconceptions

Understanding respiration: Students need to be clear about the purpose of oxygen in the human body and extend this knowledge to all living things. The purpose of oxygen is not given enough importance with respect to plants in the curriculum and hence the misconception that carbon dioxide can replace oxygen for respiration in plants, could have developed.

Difference between breathing and photosynthesis: Breathing is only a physical exchange of gases, whereas photosynthesis, as the word suggests, involves 'making food in the presence of light'. The misconception that both the processes are the same could have come about because of the importance and uniqueness of the process of photosynthesis.

Differences between breathing and respiration: The challenge is to move from a mechanical description of what is happening in 'breathing' to an explanatory account of why respiration is important.

Complexity in the process: The gases in the plants reach each individual cell through diffusion. This is fairly difficult to understand and also added to the complication is the fact that plants use both carbon dioxide and oxygen.

Textbook depiction: Most textbooks depict only the breathing process involved in human beings and a few other animals; while for plants, it depicts only photosynthesis.

Implications for Teaching

One of the probable solutions is to use the 'Student Interview Approach' after the students answer a test/question. This will enable the teacher to go deeper and find out how students think through an idea or a concept.

Students often grapple with individual concepts and are not able to link them up. The curriculum design probably needs to tackle this issue and approach the concepts in a more holistic way. Students should be able to link up and understand the processes that are common to all living organisms and those that are unique to classes of organisms. Also to be kept in mind is the fact that certain terms like 'diffusion' can be introduced only after probably grade 6.

It is important to realise that worldwide these misconceptions exist and they are not unique to only the Indian curricula.

It's very important to understand how students think. Assessment, whether it be before teaching a particular concept or after teaching it, is as important as the content of the concept being taught. Assessment should be used as a tool not just to know what students have learned but also to understand the way students learn. And framing a good lesson plan or a good teaching module cannot be done without understanding how students will learn in a given environment or with a set of alternate conceptions.

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Centre for Cellular & Molecular Biology (CCMB)

Former President APJ Abdul Kalam dedicating LaCONES to the nation

CSIR IN THE SERVICE OF THE NATION

The Council of Scientific and Industrial Research (CSIR) was established in 1942 with the primary objective of advancement of scientific knowledge and sustained industrial development of the country. Over the years, CSIR has created a base for scientific capability and excellence. It has also been training researchers, popularizing science and helping in the inculcation of scientific temper in the country. The CSIR today is a well knit and action-oriented network of 38 laboratories spread throughout the country with activities ranging from molecular biology to mining, medicinal plants to mechanical engineering, mathematical modelling to metrology, chemicals to coal and so on.

To give our readers an insight into the contributions of CSIR to Indian S&T, we are starting a series highlighting the most significant achievements of the CSIR laboratories.

From DNA Fingerprinting to conservation of endangered species, from far-reaching genetic studies to efforts at containing infectious diseases and genetic disorders, the Centre for Cellular & Molecular Biology, Hyderabad has contributed immensely to the field of molecular biology in the country.

ON 14 March 2006, the birth of Spotty was reason enough to celebrate for a group of excited scientists. It was for the first time in India that an artificially inseminated female spotted deer had delivered a live fawn. With the successful artificial non-surgical intra-vaginal insemination in the spotted deer, India joined Australia and the United States, the only other two countries to have achieved this remarkable feat through a non-invasive procedure. And the proud scientists who made this possible were from the Centre for Cellular and Molecular Biology (CCMB), Hyderabad.

The CCMB scientists notched up the successful feat at a special facility called the Laboratory for the Conservation of Endangered Species (LaCONES), which owes its existence to

Former President Abdul Kalam visiting CCMB lab (left); Director CCMB, Dr Lalji Singh (above).

Many prestigious international and national awards have come to CCMB including the FICCI Award for outstanding achievements in Science & Technology etc.

DNA-based studies on wildlife at the CCMB. This facility that has now become fully functional is expected to go a long way in conserving endangered animal species as its sperm, egg and cell banks will help in producing animals on the verge of extinction. By all counts a great contribution to conserving India's rich biodiversity.

The Centre for Cellular and Molecular Biology has tasted several similar successes in the past too that have positioned it as one of the most premier laboratories working in the area of modern biology. In 1988, CCMB developed the DNA Fingerprinting technology for the first time in India, which helped solve many high profile sensational cases. The Kerala High Court accepted it as infallible evidence in 1990 for the first time. In fact, DNA Fingerprinting almost became a signature technology intimately associated with this remarkable CSIR laboratory.

Scientists of the lab even developed an indigenous DNA probe from the blood of an Indian branded krait snake, which is not only much less expensive than the probes used in other countries, but also gives a more reliable result. The popularity and effectiveness of the technology can be gauged from the fact that a new Centre for DNA Fingerprinting and Diagnostics (CDFD) was set up in Hyderabad to handle all DNA fingerprinting cases in the country.

The Initiation

The Centre for Cellular and Molecular Biology had its beginning as a semi-autonomous Centre on 1 April 1977 in the Indian Institute of Chemical Technology (IICT), then called Regional Research Laboratory (RRL), Hyderabad campus with the Biochemistry Division as its nucleus. The CSIR had approved the proposal to establish this Centre in 1976 and it became a full-fledged national laboratory in 1981-82. Late Prime Minister, Shri Rajiv Gandhi, dedicated the present building complex of CCMB to the nation in 1987.

The primary emphasis of the CCMB is on doing basic research in biological sciences, including the areas of Biophysics and Biochemistry, Cell Biology and Development, Genetics and Evolution, Molecular Biology, Genomics and Proteomics, and Biotechnology and Biomedicine. The other objectives of the Centre are to aid the development of biotechnology in India, conduct training courses in modern biology, promote centralized national facilities for new and modern techniques in the inter-disciplinary areas of biology, interact with industry carrying out basic and applied work, and to collect, collate and disseminate information relevant to biological research.

The CCMB (left); Laboratory for Conservation of Endangered Species (LaCoNES) (right).

State-of-the-Art-Facilities

The core strength of CCMB lies in the maintenance of infrastructure and instrumental facilities. Since its inception, CCMB empha sized for centralized facilities in the country for new and modern techniques in the interdisciplinary areas of biology. Today, CCMB has succeeded in acquiring up-to-date and multi-user facilities for Proteomics, Automated DNA Sequencing, Microarrays, Advanced Microscopy and Imaging, Advanced Spectroscopy I & II, Flow Cytometry, Transgenic and Knock-out Mice, Confocal Microscopy, X-ray Crystallography, Transmission, Scanning and Cryo-Electron Microscopy, a prefabricated BSL3, NMR (600 MHz) Micro-imaging and High Resolution Spectroscopy, Laboratory Animals with SCID and Nude Mice, Bioinformatics, Digital Imaging and Digital Photography, -20°C Walk-in Cold Room for storage of fine chemicals and many other minor facilities.

In addition, CCMB has a Green House, Growth and Tissue Culture Chambers, Nectar for maintaining fruit-flies, Library, Haldane Collection, an international style Guest House for visitors' stay, an excellent Housing Complex for staff, a well equipped 6-storeyed Hostel for students and Arogyadham, a physical fitness center for the welfare of its staff.

Educational and Training Programmes

The Centre imparts training to doctoral students linked with the Jawaharlal Nehru University, New Delhi, and an active post-doctoral research programme sponsored by DBT, DST and CSIR. In addition, CCMB provides training in the areas of modern biology for research workers from India and abroad, and summer training to 1st year PG students. Short-term courses and workshops are periodically arranged in specialized areas of modern biology.

Conservation Facility

One of the most significant contributions of CCMB has been towards conservation of the country's endangered species. DNA-based studies on wildlife at the CCMB have paved the way for a new national facility, the Laboratory for the Conservation of Endangered Species (LaCONES). It has been set up on 7 acres at Attapur, Hyderabad, in collaboration with the Central Zoo Authority of India (CZA), DBT, CSIR and the Govt of Andhra Pradesh.

Proposed in 1998, and dedicated to the nation on 1 February 2007 by Dr A.P. J. Abdul Kalam, the then Hon'ble President of India, LaCONES is aimed at the conservation of endangered animals through the use of biotechnological intervention. Among the wide range of objectives initiated under this project are monitoring of genetic variation using modern techniques such as DNA fingerprinting, establishment of cell banks and gene banks through cryo-preservation of semen, eggs and embryos of endangered species, and the development of assisted reproductive technologies such as artificial insemination, in-vitro fertilization as well as embryo transfer and cloning.

Unmatched in scale, LaCONES is a world-class facility catering to the needs of not only big cats such as lions and tigers, but other endangered animals also such as deer, non-human primates and birds. Through assisted reproductive technologies, scientists at LaCONES have already achieved pregnancy in chital and blue rock pigeon. "Blacky," a fawn of the endangered blackbuck antelope is the latest to have been delivered using artificial insemination.

In recognition of its exemplary achievements, LaCONES was honoured recently as a Member of the International Consortium of the Frozen Ark – an international depository of DNA.

Infectious Diseases

Yet another major initiative taken by the CCMB centers around infectious diseases that are breaking international barriers and affecting people globally, such as SARS, Japanese Encephalitis and Avian-flu. CCMB has proposed to set up a world class Biological Safety Level 4 (BSL4) facility to contain such biohazardous microorganisms. Realizing the importance of such a facility to be annexed to the CCMB, the Government of Andhra Pradesh has allotted 5 acres of land near CCMB for setting up of this facility for the purpose of medical biotechnology.

The BSL4 facility would also help in scientific evaluation of sudden outbreaks of diseases like the Nipah virus, West Nile virus and other such agents of unknown etiology. The facility would generate animal models for the diseases to carry out new drug trials on them. In turn, this will facilitate drug and vaccine development by other research organizations and pharma as well as biotech industries.

Translational Research

CCMB has also taken a pioneering step to set up a new Clinical Research Facility for stem cells and regenerative medicine (CRF) in collaboration with the Nizam's Institute of Medical Sciences (NIMS), Hyderabad. This novel concept proposed by the CCMB had been accepted and approved by the DST, Government of India. This will house facilities for Cell and Tissue Engineering, Regulatory RNA in Development and Disease, Stem Cell Research and Functional MRI, in Phase I. The foundation stones for these two facilities were laid on 3 November 2007 by Hon'ble Kapil Sibal, Vice-President, CSIR and Union Minister for Science & Technology and Earth Sciences.

The proposed Phase II facility will come up in the campus of NIMS. The CCMB has also proposed setting up of a novel Centre, "Institute for Translational Research", which has been approved by the Planning Commission asking CSIR to let CCMB set it up. The Government of Andhra Pradesh is considering allotting 75 acres of land to set up this facility, though for the overall requirement and future expansion a minimum of 150 acres of land would be required.

Research Achievements

The CCMB is well acclaimed for some path-breaking research achievements of its scientists. Some are being mentioned here.

Molecular basis of sex determination: Isolation of highly conserved sex chromosome-specific minor satellite DNA from the female branded krait (Bkm) snake had paved the way for identifying a sex- and tissue-specific Bkm-binding protein, which was found to be involved in modulating chromatin conformation and activity of sex chromosomes.

DNA fingerprinting technology: CCMB developed, for the first time in India, a Bkm-derived probe for DNA

The Third World Academy of Sciences TWAS, Italy, has also designated it as a South Centre for Excellence for Research and Training.

fingerprinting as fallout of the work on the mechanisms of sex determination. This probe is being extensively used for forensic investigation, paternity determination and seed stock verification.

Molecular diagnosis of common genetic disorders: CCMB is extending its services to reduce the burden of genetic disorders in the society by taking up molecular diagnosis, carrier analysis, predictive diagnosis, prenatal diagnosis and genetic counseling. Six hundred families have benefited so far with genetic diseases like haemoglobinopathies, musculopathies, neurodegenerative disorders, bleeding and clotting disorders and other congenital anomalies.

Genetic causes of male infertility: Oligoasthenospermia, one of the causes of male infertility, is characterized by poor semen quality and motility. Sperm motility is greatly influenced by mutations in the mitochondrial DNA (mtDNA). Analyses of the mitochondrial DNA of fertile men from the Indian subcontinent revealed a novel missense mutation in ND4 (C11994T) gene, which replaced threonine with isoleucine in all the oligoasthenospermic men. This study provides useful information that can be utilized by infertility clinics for adopting suitable assisted reproduction methods.

First gene knockout mouse: CCMB has joined the select club of institutions from a few advanced nations by successful production of a gene knockout mouse strain for the first time in India. It has genetically engineered a mutant strain that lacks one of the milk protein genes known as Kappa Casein; in the absence of this gene females are healthy and can produce pups but these females are unable to produce milk. This discovery has tremendous implications in the field of mammalian evolution, lactation biology and genetics and dairy chemistry.

Counting the Tigers right! It is difficult to count tigers visually; therefore, indirect and non-invasive methods are more suitable for counting their population. A DNA-based method was developed for identifying the scat samples of tigers from those of the other carnivores. DNA was isolated from the scat samples collected from the study areas and gender identification of the samples was also performed. DNA profiling showed that samples collected from forests could be assigned to individuals and indicated that it is possible to conduct large-scale studies in India.

Birth of Blacky by artificial insemination: CCMB has, for the first time, succeeded in producing a fawn of the endangered blackbuck antelope through estrus-induced artificial insemination. While surgical intra-uterine insemination, an invasive procedure, has produced young ones of the cheetah, leopard, puma, wild cat and deer elsewhere in the world, this is the first time ever that a non-surgical intra-vaginal insemination – a non-invasive procedure preferred by wildlife biologists – has produced a baby, named Blacky.

Universal technique to establish species' identity: For the first time anywhere in the world, CCMB developed a novel, simple and quick method for establishing the identity of animal species in a universal manner. The technique utilises a pair of novel primers, namely, mcb398 and mcb869, in polymerase chain reaction (PCR) and if used in food fortification where identity of edible meat sources is to be established. CCMB, under wildlife forensics, has resolved more than 227 cases forwarded by various wildlife curators and crime investigating agencies.

Genetics of osmoregulation: A gene called ProU has been discovered in *E. coli* and its role established in osmoregulation leading to the development of a recombinant DNA technology to produce polypeptides of commercial importance.

Novel *in vivo* system for screening and validation of anticancer drugs: Transgenic fruit flies (*Drosophila*

Patents Granted

- DNA sequence for root preferred gene expression in plants (US).
- Universal primers for wildlife identification (US).
- Indolicidin analogs with antimicrobial activity (US).
- Chimeric protein, a BNAC crystalline with extraordinarily high chaperone like activity and a method related to the use thereof (US).
- A novel process for producing polypeptides (US, India).
- Preparation, characterization, ESR and PAS studies of $Cu0_5$ $NbAlP_3O_{12}$ and $HnbAlP_3O_{12}$ (US)
- Bacterial mutant BX065 and a method thereof (Shikimate dehydrogenase as a target for developing novel bactericides against plant pathogens) (US).
- Universal primers to establish the identity of animal parts and products (RSA)
- A composition useful for the detection and estimation of nanogram quantities of protein(s) present in fluid (India).
- Process for synthesis of novel cationic amphiphiles containing N-Hydroxyalkyl group for intracellular delivery of biologically active molecules (US).
- DNA markers for assessing seed purity (US, Bangladesh, China)
- Cationic amphiphiles containing N-hydroxyalkyl group for intracellular delivery of biologically active molecules (US B1 & B2).
- Use of DNA encoding a promoter or promoters along with CIS regulatory elements and a novel process for producing polypeptides (Japan).
- Process for synthesis of novel cationic amphiphiles containing N-hydroxyalkyl group for intracellular delivery of biologically active molecules (US).
- A process for the preparation of a formulation useful for the detection of proteins present in biological fluids (India).
- Process for identifying mutagens and antimutagens (US)
- Lymphocyte stimulating factor from trypanosoma (Canada)
- Immobilised biological membranes (US).
- Lymphocyte stimulating factor (US)
- Method of treating Leishmaniasis using methyl-beta-cyclodextrin (US)

With the successful artificial non-surgical intra-vaginal insemination in the spotted deer, India joined the rank of Australia and the United States

melonagaster) have been generated, which enable targeted expression of human protein encoded by the gene Adenomatous polyposis coli (Apc), a tumor-suppressor gene. Individuals with defective Apc are vulnerable to colon cancer. CCMB has been using human Apc-induced eye deformities as an *in vivo* assay system to identify and validate potential anti-cancer drugs.

Origin of the vanishing Andamanese: CCMB scientists analyzed the DNA from Andamanese hair locks and members of the three present day Andamanese tribes. The genetic data, which included maternally inherited mitochondrial DNA sequencing and paternal Y chromosome markers, has revealed that two tribes in the Andamans are the descendants of the people who migrated about 70,000 years ago from Africa. This is considered to be a path-breaking work showing that Onge and Great Andamanese (negreto tribes) have evolved in the Andaman Islands in genetic isolation independently.

For the first time, genetic evidence has been provided in support of out-of-Africa theory and it has been proposed that there was only one wave of migration out of Africa through the Southern sea route via India. It looks likely that the first humans crossed the Red Sea and spread to Australia via India and Southeast Asia through the Southern Coastal route. This is in contrast to the prevailing concept of Northern route of migration.

The most recent findings of the CCMB scientists indicate that Indian mtDNA pool consists of several deep rooting lineages of macrohaplogroup 'M' suggesting *in situ* origin of these haplogroups in India and their subsequent migration to Southeast Asia. These studies further support one wave of rapid dispersal theory of modern humans along the Asian Coast.

Understanding human development: CCMB, in collaboration with IICT, presented path-breaking results, using fruit fly as a model, of how the interfering RNA (RNAi) machinery contributes to nuclear organization and gene expression. Investigations on how different developmental genes are regulated through RNAi machinery in executing the specific body plan in a sequence-specific manner, have shown for the first time that RNAi machinery not only influences the regulation of a specific gene but also helps in bringing the genes from different chromosomes together promoting higher-order nuclear organization which is essential for the development and maintenance of the organism.

Can gene silencing control diseases? It was demonstrated, for the first time, that the small interfering RNAi plays a crucial role in gene silencing at a specific site during conversion of euchromatin to heterochromatin and in assembly and maintenance of heterochromatin components. Diseases coupled with cell division and cell proliferation, such as cancers, appear to be controlled by heterochromatin formation. Thus, understanding the role of RNAi in cell cycle would lead to a possible RNAi-based therapy for cancers and other related diseases.

Development of disease-resistant rice varieties: *Samba Mahsuri* is considered as one of India's finest rice varieties because of its high yield and exceptional quality characteristics. However, it is susceptible to several pests and diseases, including bacterial leaf blight (BLB). In collaboration with the Directorate of Rice Research, Hyderabad, CCMB developed BLB-resistant Samba Mahsuri derivatives retaining the original traits of yield and quality.

Genetically engineered enzyme: A lipase enzyme has been designed that can withstand temperatures high enough to be used in detergent-manufacturing units. A lipase gene from the bacterium *Bacillus subtilis* was isolated and mutated genetic sequences produced from it were introduced into another bacterium, *Escherichia coli*, which began to express the protein. After screening thousands of such "variant proteins" that can "tolerate" high temperatures, CCMB has finally identified a thermostable lipase variant of commercial importance.

New gene implicated in pancreatitis: Chronic pancreatitis leads to dysfunction of a very important digestive organ called pancreas. CCMB, in collaboration with the Asian Institute of Gastroenterology (AIG), Hyderabad, has established that in Indians chronic pancreatitis has a different genetic basis than that in Europeans and Americans. A mutation in cathepsin B gene was identified in patients for the pancreatic damage due to co-localization of cathepsin B with trypsinogen to the zymogen granules leading to premature activation of trypsinogen. The CCMB-AIG study has the potential for the development of a genetic screening test for susceptibility to chronic pancreatitis in Indians at an early age.

First-ever evidence of bacteria from the stratosphere: For the first time in the world, CCMB conducted analysis of sampled air collected from the stratosphere and identified four new species of bacteria namely, *Bacillus aerius* sp. Nov., *Bacillus aerophilus* sp. Nov., *Bacillus stratosphericus* sp. Nov. and *Bacillus altitudinus* sp. Nov. They are unique in their ability to withstand high levels of ultra-violet radiations and also in their ability to utilize very low levels of sugars and other organic compounds as the only source of carbon.

Protection from Leishmaniasis: For the first time it has been shown that cholesterol depletion from macrophage plasma membranes using methyl-ß-cyclodextrin results in significant reduction in the extent of leishmanial infection and this reduction can be reversed upon replenishment of cell membrane.

DNA macrochip for ophthalmic infections: CCMB has designed and developed unique probes for identifying 15 microorganisms that cause ophthalmic infections. The prototype of DNA macrochip developed could successfully identify all the pathogens in the clinical samples at different hospitals accurately. The primers, probes and the protocol have been handed over to a commercial company for packaging and product development.

CCMB—The Director

Dr Lalji Singh, Director of the Centre for Cellular and Molecular Biology (CCMB), Hyderabad was born on 5 July 1947, in the Jaunpur district of Uttar Pradesh. After B.Sc. in 1964 and M.Sc. Zoology in 1966, Lalji was awarded Ph.D. in 1971 by the Banaras Hindu University for his work on "Evolution of karyotypes in snakes".

Staring off as Research Associate at the Department of Zoology, Banaras Hindu University during 1970 to 1972 and later on as Pool Officer at the Calcutta University during April-September 1974, he was awarded the Commonwealth Fellowship in 1974 to carry out research at the Edinburgh University U.K. In June 1987 Lalji came back to India and joined the Centre for Cellular and Molecular Biology (CCMB), Hyderabad as senior scientist.

Areas of his research interest involve molecular basis of sex determination, DNA fingerprinting, wildlife conservation, silkworm genome analysis, human genome and ancient DNA studies.

Dr. Lalji Singh and his colleagues developed a probe called Bkm-derived probe for DNA fingerprinting, which brought CCMB into the limelight. Since then this probe is being extensively used for forensic investigation, paternity determination and seed stock verification. For the first time in the annals of Indian history DNA fingerprinting evidence was presented in the court of law. The Kerala High Court upheld the verdict and since then this indigenous technique has been used in more than 300 cases including sensational cases such as assassination of the Late Prime Minister of India Shri Rajiv Gandhi etc. This fetched him and his group the CSIR Technology Award for the year 1992 for biological sciences.

This unique work of Lalji, prompted Government of India's Department of Biotechnology (DBT) to form an autonomous institution called the "Centre for DNA Fingerprinting and Diagnostics (CDFD)" in 1995. As its Officer-on-Special-Duty (OSD), Lalji worked towards development, acquisition and standardization of protocols for carrier detection, prenatal diagnosis and genetic counseling for all the genetic disorders prevalent within India.

In July 1998 he was appointed the Director of the Centre for Cellular and Molecular Biology (CCMB), Hyderabad. He has guided several students and research workers both at CCMB and CDFD. He is a recognized guide for Ph.D. of the Jawaharlal Nehru University (JNU), New Delhi and University of Hyderabad, Hyderabad.

Awarded a Padma Shri in 2004, Dr Lalji Singh has been honoured with many other prestigious awards that include VASVIK Research Award (1992), Ranbaxy Research Award (1994), Prof. S.P. Ray-Chaudhari 75th Birthday Endowment Lecture Award (1994), Prof. Vishwa Nath Memorial Lecture Award (1995), Jagdish Chandra Bose Award for research in Life Sciences (1995), Haldane Oration Medal (1996), Sri Om Prakash Bhasin Award for Science & Technology (1996), Padmabhushan Dr. P S Siva Reddy Endowment Award (1997), Joy Govind Law Memorial Medal of 1997, Dr. Yellapragada Subbarow Memorial Oration (1998), Indian Academy of Neurology Oration (1998), Honorary Professor, University of Hyderabad (1998) and Scroll of Honour - Outstanding Forensic Expert Award (1998); FICCI Award 2002-03 for R&D in Life Sciences by the Federation of Indian Chambers of Commerce and Industry, New Delhi (2003); J C Bose National Fellowship awarded by Department of Science & Technology (2006-2011), and several others.

First report of trans-splicing between a Y chromosomal and an autosomal transcript: CCMB has presented unequivocal evidence, for the first time, that a 40 Mega base repeat block of the Y-chromosome, which was earlier perceived as junk DNA, is transcribed into RNA but not translated into protein. In essence, junk DNA present in human Y-chromosome interacts and controls the function of a gene (cell division kinase) located on another chromosome (chromosome number 1), by a mechanism called trans-splicing, which is not limited to a sex. This study opens up a new approach to unravel the function of the non-coding DNA in our genome.

Development of species-specific microsatellite markers: Microsatellite markers have been developed for many species, namely, Mulberry, betelvine (plants of economic importance) and Red Panda/Olive ridleys (endangered fauna). These markers are useful in germplasm characterization and population studies

The CCMB scientists notched up the successful feat at a special facility called the Laboratory for the Conservation of Endangered Species (LaCONES).

on these species. A highly efficient PCR-based pre-cloning enrichment strategy for generating small-insert genomic libraries for development of species-specific microsatellite markers was also developed.

Worldwide Recognition

In a very short time, the excellence of the scientific and support personnel, state-of-the-art infrastructure facilities, excellent instrumental facilities, world-class research, extensive linkages with like-minded institutions abroad and within the country and a strong societal component have combined to catapult CCMB into a Centre of Excellence as chosen by UNESCO Global Network for Molecular and Cell Biology MCBN. The Third World Academy of Sciences TWAS, Italy, has also designated it as a South Centre for Excellence for Research and Training.

Many prestigious international and national awards have come to CCMB including the FICCI Award for outstanding achievements in Science & Technology; CSIR Technology awards for DNA fingerprinting technology in 1992 and for rDNA technology of salt-inducible expression for protein production in 2000; and CSIR Technology Prize for a transgenic Drosophila system for screening and validation of potential anti-cancer agents in 2003.

CCMB has also been selected as a Member of the Human Proteome Organization (HUPO), USA and a Potential Partner of the International Coffee Genomics Network (ICGN), Paris, France.

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KAMAKSHI SHARMA

Carbon Credits

The concept of Carbon Credits is fast gaining currency in a world plagued with environmental destruction due to rising greenhouse gases in the atmosphere. However, very few know what the concept is all about. Here the basic idea behind Carbon Credits is brought to you in the form of a short story.

ATUL heard the widow of Rajashekhar, Rajyalaxmi's inconsolable crying. Another farmer had committed suicide. Loans to farmers were mounting and the lack of rains for the third successive year had ruined the crop, and many lives too.

As he picked up the day's newspaper, the bold headlines announced: *Tristar earns $100bn Contract from Roche Pharmaceuticals.* Another corporate from India was making progress in the international arena. Indians were storming the international economy in Biotechnology, IT, Clinical Trials, Research and many other fields. But agricultural performance in some regions, particularly Maharashtra and Andhra Pradesh, was miserable.

"Keep away from farming!" His father would snarl whenever he would show interest in farming. "There's no future in it! Get into the best college and study computers. Stay away from all that looks green because it is the colour of death, farmers' death!"

"But we can't eat computer codes when we feel hungry. Someone has to grow food!" Atul argued.

"No farmer can survive if there is no rain and the temperature is 50^0 F for four years in a row. The situation is hopeless. Go study."

Atul went back to his books. But the smell of the soil, the feel of the plants and being amid nature excited him, not dry equations. He shuddered at the thought of spending his life in the closed confines of an air-conditioned building. To him, fulfilling the basic needs of the human race appeared a more rewarding job. But the inclement weather had a drastic impact on agriculture. Snow in the Himalayas was melting, global warming was a reality and agriculture had become a gamble.

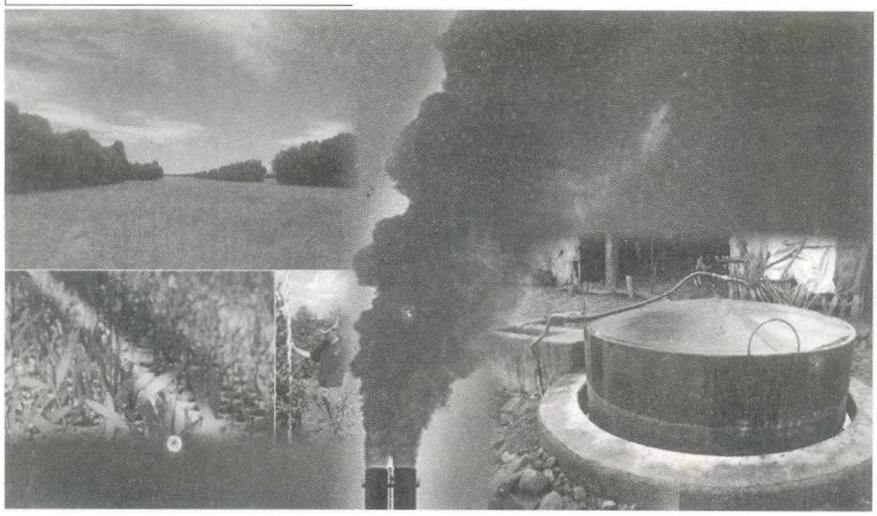
Atul was preparing for his final year examination in Agricultural Engineering. Contrary to his father's wish, he had pursued graduation in Agriculture even though he had secured admission in the Computer Science and Engineering Stream in IIT. His father had been furious but relented when his school teacher assured him he wouldn't plough the fields but work in reputed agricultural institutes!

Tired of studying, he went outside. The night sky was sprinkled with stars and the moonlight cast a milky white hue over the ready crops, which swayed with the wind. The breathtaking landscape had the feel of a dreamland. The silence and the beauty of nature were healing. Reluctantly, he went back to his room. It was time to study.

The next day they were all tense as they waited. The village Pradhan had asked them to collect for an important meeting presided by a top official from a reputed car manufacturer.

Exactly at 6:00 pm, the official arrived. The man on reaching the dais stood in silence and cleared his throat.

"I am Dr. Shrikant Verma, GM of Stan Motors," he began. "I read in the newspapers about the problems of farmers in this region. To top it, the climate hasn't been good for five successive years and there are no signs things will become better. The effects of global warming are being felt all over the world."



After an exchange of pleasantries, he came straight to the point. "I think we should try postponing the decision to sell land for sometime."

A pall of gloom descended over the gathering.

"Many of you have been trying to sell your land but why should anyone buy them? What possible good can come from it? This is exactly the reason land prices here have come down by 50 percent in last five years."

"He has done his homework before coming here," Atul remarked.

"Gentlemen, I have a proposal. Stan Motors intends to buy land, to set up a manufacturing unit. We are not looking at small, scattered tracks, but consolidated land. And to achieve it, we'll buy your land at a price that's nearly twice the prevailing prices. We have permission from the government and intend to invest millions of dollars to create new jobs and prosperity for all. If you have any questions, you may ask."

The entire gathering was abuzz with excitement.

"Wow! That's good news." Atul's father grinned.

"If everyone makes cars, computers and material things, how will the world get its food?" Atul voiced his concern.

"Don't be ridiculous. You know how difficult it is to earn a living from agriculture," his father retorted.

"No, Dr. Shrikant, I don't think all villagers will agree to sell their land," the Pradhan said over the microphone. "Most will sell, yes, but the consolidation that you seek will be difficult to achieve. We have been farmers since centuries and there will be many who won't give up their roots."

Atul grinned at his father. "Some people still think like me."

"The Pradhan is getting old," his father grumbled.

"So why don't we check it out? Let's have an impromptu vote." Shrikant suggested. "All those of you who would like to sell your land, please raise your hand."

Fewer than half of the people raised their hand. Dr. Shrikant took out his handkerchief and mopped his forehead.

"Let me consult the President of my company on this." He took out his cell phone and dialed a number. After a brief conversation, he put the cell phone back in his pocket.

"Good news! The President has agreed to up the offer. We'll pay you three times the prevailing highest offer for your lands. And this is the final offer. We'll wait for your response for a month. If you don't respond, then we'll assume you are not interested and take the offer to villages in Andhra."

Dr. Shrikant left after speaking to the Pradhan and village elders.

The new offer made Atul uneasy. It would be difficult to resist the offer.

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It was 2 am and he was restless. Most villagers had decided to sell their land. Just a few old farmers and surprisingly, the Pradhan, were reluctant. But the other villagers were stepping up the pressure on those resisting the offer. The outcome was predictable. The sale would take place. It was just a matter of time.

For Atul, the impending sale was one more instance of commercialization at the expense of agriculture. What would people do with cars if food became scarce? They would contribute to the burden on the earth, increase pollution and produce greenhouse effect. Where and when would it stop?

When he slept, he dreamt of the earth and pollution. And he dreamt of carbon. He tossed as he saw the carbon lattices in his sleep. Then he got up with a start.

Carbon! Carbon Credits! Why hadn't he thought of them before!

He went straight to his laptop and searched for Carbon Credits. One Carbon Credit was selling at 100$ in the European markets!

His pulse was racing. He typed, "Companies needing Carbon Credits" in the search engine of his explorer. With a silent prayer, he pressed enter.

In the next five minutes he had the website addresses of almost 100 companies.

He typed the draft of a letter and then spent an hour tuning its content. Satisfied, he mailed it to the 100 companies, not wanting to leave anything to chance.

He finished by nine in the morning. And his eyes were burning with strain. He lapped the stuffed paranthas his mother made with relish.

"You didn't sleep the whole night?" She asked him.

"How do you know?"

"Your eyes are swollen. Get some sleep."

She pulled the curtains and shut the door of his room from outside. This time he fell into a dreamless sleep.

****

It was 3 in the evening when he got up. Remembering his efforts of the night before he switched on his laptop. There were five mails in his inbox and he smiled when he finished reading them. Quickly he rushed to the house of the village Pradhan.

After an exchange of pleasantries, he came straight to the point. "I think we should try postponing the decision to sell land for sometime."

"Why? Your father is the most vocal among the people who feel we should sell our land."

"Yes, but I have discovered a potential that makes the Stan Motors offer insignificant."

"How?"

"If we continue with agricultural activities, then we can earn Carbon Credits and bring prosperity in the village, not in rupees but dollars. Imagine earning foreign exchange!"

"Carbon Credits?" the Pradhan scratched his head. "What is it?"

"Carbon Credits are a tradable permit scheme. They provide a way to reduce greenhouse gas emissions by giving them a monetary value. A credit gives the owner the right to emit one tonne of carbon dioxide."

"But what has this got to do with us?"

"International treaties such as the Kyoto Protocol set quotas of greenhouse gases countries can produce. Businesses that are over their quotas must buy Carbon Credits for their excess emissions, while businesses that are below their quotas can sell their remaining credits."

"Yes, but..." the Pradhan was restless.

"This is where we come into the picture. There are several businesses abroad that are willing to pay other businesses to make the reduction for them."

"Business, isn't it? But we are farmers!"

"We are also into agricultural business and can help other global organizations to meet their quota. We can exchange our positive Carbon Credits with them at the prevailing market price."

"How will we contact them? How will it happen? By the time we figure it out, the offer from Stan Motors will be withdrawn."

"I have five organizations interested in the Carbon Credits. We will sell them at prices much cheaper than the international prices. Even at those prices, we would be making hefty profits."

"But why should we sell them cheap?"

Atul laughed. "Now you are coming into your elements! We'll sell cheap because they will agree to invest in the infrastructure we will need. Tube wells, good seeds, machinery, technology for rain harvesting, retractable roofs, all the things that we might need!"

"Why would they do it?"

"Because it will be a collaboration. Don't you see? A different collaboration from the one Stan Motors is going to do. While they will make cars for foreign companies, cheaply here in India and earn foreign exchange, we'll be collaborating with the organizations interested in our Carbon Credits. In the Stan Motor scenario, they get rich, but in the Carbon Credit scenario, we'll be the ones who will get rich!"

"You have a plan?"

"Yes. We will have to consolidate land, unite to share work and the challenges. Like Stan Motors, our collaborators will not invest in individuals, but a cooperative. We will have to make a cooperative."

"Are you sure, we will be able to pull this off?"

"Yes. I will try to get them to sign an agreement. We will sell the land to Stan Motors only if we are unable to secure an agreement before the deadline!"

"Don't lose on this one."

"Can you put the sale on hold for another 10 days."

"Eight days at the most. After that I won't be able to stop your father and his team!" the Pradhan smiled.

"But why do these organizations need Carbon Credits?"

"Carbon Credits came into existence because of increasing awareness of the need for pollution

What made the victory and the revolution especially sweet was that planet earth was limping slowly back to normalcy. The greenhouse trends were showing signs of reversal. There was hope and optimism.

control. The Kyoto Protocol provides for three mechanisms that enable developed countries with quantified emission limits and reduction commitments to gain greenhouse gas decline credits. These mechanisms are Joint Implementation (JI), Clean Development Mechanism (CDM) and International Emission Trading (IET)."

"So how does money come into the picture?"

"Under JI, a developed country with high costs of domestic greenhouse reduction would set up a project in another developed country that has a low cost. Under CDM, a developed country can take up a greenhouse gas reduction project in a developing country where the cost of greenhouse gas reduction project is usually much lower. The developed country would be given credits for meeting its emission reduction targets, while the developing country would receive the capital and clean technology to carry out the project. Under IET, countries can trade in the international Carbon Credit market. Countries with surplus credits can sell them to countries with quantified emission limits and reduction commitments under the Kyoto Protocol."

"I see! It means all that you are talking is possible!"

"Yes. Carbon Credits have created a market for reducing greenhouse emissions by giving a monetary value to the cost of polluting the air. Carbon has become a cost of business and is like other inputs such as raw materials or labour. If a factory produces 100,000 tonnes of greenhouse emissions in a year and has a quota of say 80,000 tonnes. Then, the factory either reduces its emissions to 80,000 tonnes or is required to buy Carbon Credits to offset the excess."

"And so the need to buy Carbon Credits!"

"Yes. A business would buy the Carbon Credits from open market from organizations approved to sell legitimate Carbon Credits. One seller might be a company that will plant so many trees for every Carbon Credit you buy from them. So, for this factory it might pollute a tonne, but is essentially now paying another group to go out and plant trees, which will, say, draw a tonne of carbon dioxide from the atmosphere. Since emission levels have been rising over time, the number of companies wishing to buy more credits have increased, pushing the price of one Carbon Credit to 100 US$."

"Good thinking, Atul! I think it is not a coincidence that you became an agricultural engineer!"

****

At 8:00 pm, the same night, he received a call.

"Is that Atul?" the voice was distinctly American.

"Yes."

"I am George Moore, Vice President, General Motors, USA. We received a proposal from you and are interested in pursuing it. Could you fly down here and meet us? We'll send you the air tickets."

"No. Because time is short..." And he told George Moore about the pending deal with Stan Motors.

"Oh, I see. No problem, I will send a team to you in three days. Just keep the deal at bay till you see what we can offer."

When he put down the cell phone he shut his eyes and then screamed so loudly that his parents came rushing to him.

"What happened?"

"You will know in three days," he grinned.

****

Another meeting, but this time organized by Atul along with the village Pradhan. The five member team from the USA sent by General Motors presided over it and explained the collaborative plan that they had chalked out. They would invest millions of dollars in agricultural infrastructure and buy Carbon Credits at a discounted rate. And when Atul spoke of the projected incomes and benefits to the villagers from the joint venture, the entire village agreed to consolidate their land, register it as a cooperative with shareholders in proportions of the land holdings. Atul even had a name ready for it—C-Green Cooperative. It would be India's first collaborative agricultural venture with a global giant.

****

He got down from his small car. Though he could now afford a big one, he didn't wish to pollute the environment unnecessarily. It was a tiring day. He had been to three villages to share his vision and promote Carbon-Credit led growth in them too. Now, despite his fatigue, he felt proud as he looked at the lush green environment of his village. It had become a model village and had appeared in the *Times* magazine, with a write up about him.

More villages in India were following his ideas and innovative techniques. Strong retractable roofs over fields to prevent damage because of excessive rain and sunlight, water harvesting technology, biogas plants, tube wells powered by biogas, modern harvesting machinery, sprinklers – their cooperative was equipped with the latest gadgets. The C-Green revolution was reported as the next best thing to happen in cooperatives after Anand Dairy. The villagers had prospered. Gone were the days when debt-ridden farmers committed suicide.

But more than anything, it reiterated his conviction for agriculture being important to the global economy. What made the victory and the revolution especially sweet was that planet earth was limping slowly back to normalcy. The greenhouse trends were showing signs of reversal. There was hope and optimism.

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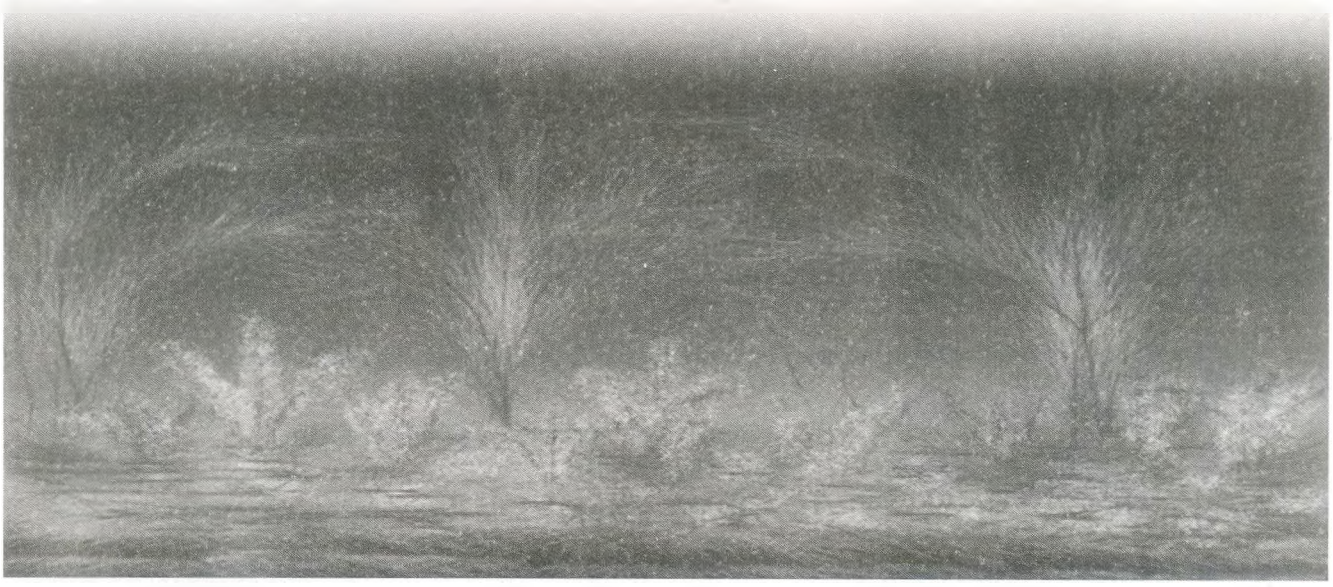
AKSHAY TALUKDAR

Breeding Crops in Space



THE ever-increasing population pressure has forced agricultural scientists the world over to look for novel tools and techniques to increase food production. Since horizontal expansion of agriculture through inclusion of more areas under cultivation has virtually met with a dead-end and threat on agricultural land has mounted due to rapid industrialization and urbanization, increase in crop productivity per unit area is the only viable alternative left to increase crop production.

Untiring efforts of agricultural scientists have resulted in the development of short-statured, fertilizer responsive, high yielding crop varieties that have revolutionized agriculture with bumper crop production (Green revolution). Application of chemical fertilizers, supply of water through irrigation, chemical protection of crops from various pests and diseases, etc., changed the agricultural scenario of the country, but it failed to sustain the going for long. This is because the yield status of the major crops has virtually reached a plateau. Hence, alternative ways are the need of the hour to keep crop production going up to meet the increasing demand.

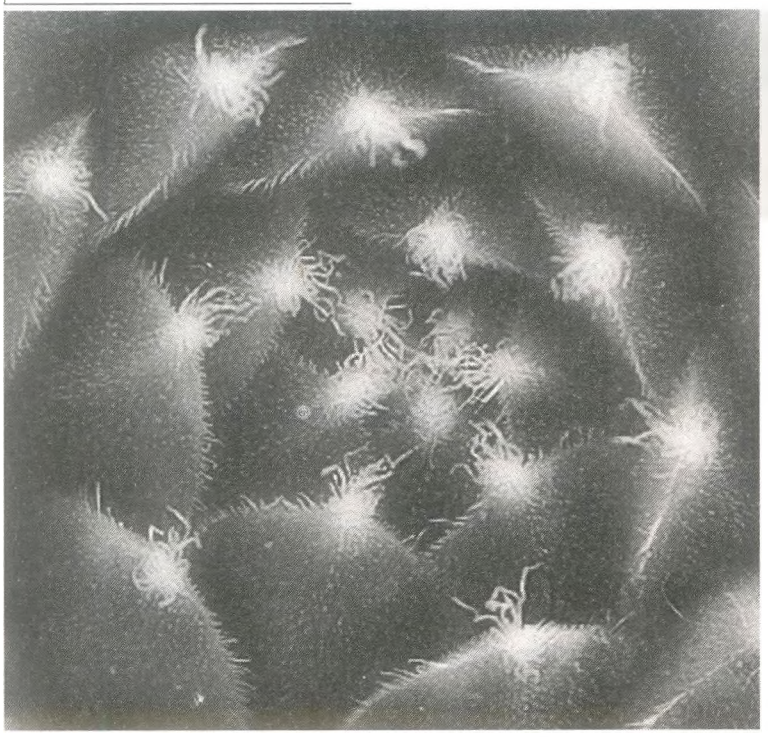
Heritable variations in genetic resources are the pre-requisite for development of a new crop variety. Such variations are sometimes available in Nature. However, all such variations may not always be useful. It prompts for creation of genetic variations artificially. Crop breeding programmes employ various approaches for creation of desirable genetic variations. Already, a large number of successful crop varieties have been developed by the available means of crop breeding. However, the gap between the demand for food crop and its supply still remains to be bridged.

In one of the latest moves, scientists have set their eyes on outer space to utilize it for increasing crop production. Such effort has added a new chapter in agricultural sciences, called "Space-Breeding".

Breeding in Space

Space breeding refers to the technique of sending seeds into space in a recoverable spacecraft for creation of novel genetic variations in it. Such space returned seeds (also called space-bred seeds) are subjected to rigorous experimentation on earth to fish out useful variants. Selected variants are tested for yield and other quality parameters, and the suitable ones are released for commercial cultivation. The useful space variants not suitable for release as variety are used to cross with the normal seed plants to produce hybrids.

Seeds are sent into space on spacecraft and are kept there for certain periods of time. Under orbital conditions in outer space, biological stress and damage are induced by the highly energetic, densely ionizing components of heavy ions. Seeds in outer space stay in weightlessness and are



Seeds in outer space stay in weightlessness and are bathed in a wide range of high-energy cosmic rays. In the condition of super-vacuum, microgravity, interchangeable magnetic field, space, etc, the seeds undergo mutation.

bathed in a wide range of high-energy cosmic rays. Moreover, in the condition of super-vacuum, microgravity, interchangeable magnetic field, long march through the space, etc, the seeds undergo mutation. Progenies of such mutated seeds exhibit genetic variations some of which may be beneficial to us. Such variations are heritable and stable for use in breeding programmes.

Progress in Space Breeding

Countries such as China, the United States and Russia are already using space-breeding technology for crop improvement. Unlike the USA and Russia who are basically interested in investigating how plants grow in space and producing foods for the orbiting astronauts, China is applying the space breeding approaches for improvement of terrestrial farming.

Since 1986, China has launched several recoverable spacecrafts with over 70 varieties of crop seeds on board. The seeds include grain and oil crops (47%), vegetables (18%), flowers, fruits, cotton, grass, and mushrooms. The first ever Chinese manned space capsule "Shenzhou-IV" (November 2003) carried on board seeds of tomato, watermelon, Chinese radish, green pepper, corn, barley, wheat, more than 10 kinds of other vegetables, and over 30 different types of herbal plants and compounds. The space-returned seeds are now under trial on various experimental stations and are exhibiting encouraging results.

Success in space-breeding technology has been remarkable. It was reported that the rice seeds bred in space mature early (earlier by more than 5-20 days) and produce 10–15% more yield than normal seeds. Several test results showed that the space-exposed seeds germinated sooner than the earth-based seeds. Also, the space-exposed seeds grew at a faster rate than the normal. Scanning electron microscopy (SEM) and X-ray analysis of the epidermis layer of the space-exposed tomato seeds revealed that the layers were more porous in the space-exposed seeds than on earth-based control seeds. This unusual characteristic may perhaps contribute to the increase in the space seeds' growth pattern.

The space-bred crops are also reported to be more delicious, vitamin-rich and also resistant to various diseases and insect-pests. *Space pepper* and *Space tomato* (as they are commonly known) is reported to grow as large as 500 grams and 800 grams, respectively. Space pepper contains more nutrients, trace elements, vitamin-C and soluble sugars. Similarly, space-bred muskmelon changed to bigger and sweeter with beautiful skin colour.

China has also expanded its space breeding technology to forestry. Over 30 kinds of space traveled herb seeds were reported to have larger leaves, stronger stem, high quality, stable heredity and stronger resistance to diseases. Seeds of poplar trees that traveled to space in "Shenzhou" for more than 160 hours showed higher germination rate with rapid growing habit. China is jubilant with the success of space-bred crops and believes that it would help the country to increase crop production with enhanced quality to feed its growing population. It has now set eyes on the International Space Station (ISS) to put some rice seeds there for long periods and test back on earth the impact of the space-stay on the seeds.

Are Space-bred Crops Safe?

Will it be safe to eat food that has been bathed with unaccounted doses of cosmic rays? Wouldn't the space-mutated seeds grow to plants that may bring ecological disaster? These are some of the questions that have been pointedly asked as far as the consumption of space-bred crops is concerned. However, scientists are of the opinion that space-bred crops are safe to eat and pose no threat to ecology. Because, unlike GM crops, space-bred crops involve no foreign genes; whatever changes occur are because of mutations of their own genes only. Hence, the space-bred crops bear no fear to human health and the environment.

Although the space-bred crops appear to be benign to the environment and human health now, however, their long-term effects are yet to be ascertained. Experience tells us that substances once thought to be safe for human consumption have been found to be deadly later. Hence, more intensive research needs to be initiated to save our future generations from paying the price of our haste.

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ADDICTION QUIZ

DEBAYAN DUTTA

1. **Addiction is…:**
   a) Intake of drug
   b) Intake of tobacco & alcohol
   c) Both (A) & (B)
   d) Physiological & psychological dependence

2. **Sports person enhance mental and physical capability by…:**
   a) Anabolic steroids b) Caffeine
   c) Whisky d) Light but calorie content of food

3. **Tea has stimulant….:**
   a) Tannins b) Caffeine
   c) Teophylline d) Both (A) & (B)

4. **Brown sugar is……:**
   a) Barbiturate b) Heroin
   c) LSD d) Morphine

5. **Pethidine is used in….:**
   a) Obtaining pleasure b) Euphoria or intoxication
   c) Anesthesia (Local) d) Enhancing Mental Capability

6. **Drug used for work for long hours without sleep….:**
   a) Caffeine b) Amphetamine
   c) Cocaine d) Betel nut

7. **Study of action of drugs is called…:**
   a) Pharmacognosy b) Pharmacology
   c) Physiology d) Pharmaceutical Chemistry

8. **Name of high alcohol content beverage…:**
   a) Beer b) Wine
   c) Whisky d) Toddy

9. **Vodka is an alcoholic beverage got from …:**
   a) Potato/grain fermentation
   b) Apple fermentation
   c) Rice
   d) Distilled product of fermented grain

10. **Motor Vehicle Act (1988) defines a drunken person one whose blood alcohol concentration is:**
    a) > 20 mg% b) 25-30 mg%
    c) > 30 mg% d) NBRI

11. **Indicator of quality of alcohol consumed by a drunken person…:**
    a) Spectro analyzer
    b) BAC indicator
    c) Alcoholmeter
    d) Breath alcohol analyser

12. **A factor responsible for cirrhosis of liver is…:**
    a) Vitamins
    b) Excess fats and oils
    c) Alcohol
    d) During starving

13. **Fatty liver syndrome is due to excessive intake of…:**
    a) Morphine b) Alcohol
    c) Tobacco d) Both (B) & (C)

14. **Blood sugar of an alcoholic:**
    a) Increases
    b) Decreases
    c) Increases during excess consumption
    d) Remain unchanged

15. **Tobacco is dried leaves of…:**
    a) *Nicotiana tabacum*
    b) *Diospyros melanoxylan*
    c) *Nicotiana rustica*
    d) Both (A)&(C)

16. **Tobacco smoking originated by…:**
    a) Red Indians (America)
    b) Europe
    c) India
    d) England

ANSWERS:

1) d	2) a	3) d	4) b	5) c
6) b	7) b	8) b	9) a	10) c
11) d	12) c	13) b	14) b	15) d
16) a				

Contributed by Shri Debayan Dutta, 2A, Girish Park North, Kolkata 700 006

GRIPPING CHEMISTRY QUIZ

VASANTHI

1. Which is 'Ammonal' in the following:
a) $NH_4NO_2 + Al$
b) $HCl + HNO_3$
c) $NH_4NO_3 + Al$
d) NH_4Cl

2. The chemical name of bleaching powder is:
a) HClO
b) ClO_3
c) $CaOCl_2$
d) CCl_4

3. The element having zero electron affinity is:
a) Chlorine
b) Argon
c) Aluminium
d) Arsenic

4. The commercial name of potassium hydroxide is:
a) Caustic soda
b) Caustic potash
c) Baking soda
d) Lunar caustic

5. An example of tribasic acid is:
a) CH_3-COOH
b) H_3PO_4
c) H_2SO_4
d) HCl

6. A double carbonate of calcium and magnesium is called:
a) Magnesite
b) Marble chips
c) Epsum salt
d) Dolomite

7. Electron Volt (e.v.) is the unit of:
a) Electro negativity
b) Electron affinity
c) Atomic size
d) Nuclear size

8. Glaubers salt is:
a) $Na_2CO_3.10H_20$
b) $Na_2S_2O_3.5H_2O$
c) $NaHCO_3$
d) $Na_2SO_4.10H_2O$

9. The valence electronic configuration of chlorine is:
a) $3s^2\ 3p^5$
b) $2s^2\ 2p^5$
c) $3s^2\ 3p^6$
d) $3s^2\ 3p^4$

10. The isoelectronic species among the following is:
a) Na^+ - Ar
b) Ca^{2+} - Ar
c) p^{3-} - Ne
d) Cl – Ne

11. A gas that is commonly prepared by Kipp's apparatus is:
a) O_2
b) NO_2
c) H_2S
d) SO_2

12. Which is 'Tear Gas' among the following:
a) $ClO_3 - N_2$
b) $C_{10}H_5\ ClN_2$
c) $HClO - N_2O$
d) $CCl_3 - CO$

13. The name of the element having atomic number (Z) 100 is:
a) Mendelevium
b) Californium
c) Fermium
d) Einstenium

14. The anhydride of carbonic acid is:
a) SO_2
b) NO_2
c) CO_2
d) P_2O5

15. Who introduced the term *pH* :
a) Sorensen
b) Sidge Wick
c) Arrhenius
d) Linus Pauling

ANSWERS:

1) c	2) c	3) b	4) b	5) b
6) d	7) b	8) d	9) a	10) b
11) c	12) b	13) c	14) c	15) a

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S.K. GUPTA &
ABHISHEK GUPTA

Pumpkin Controls Diabetes

THE common pumpkin has recently been found to be of use to diabetics. Scientists of East China Normal University, Shanghai have discovered a compound in pumpkin, known to promote the regeneration of damaged insulin-producing pancreatic beta cells in diabetic rats, thereby improving the level of insulin in their blood. The rats fed on pumpkin extract for 30 days had only five per cent less plasma insulin and eight per cent fewer insulin-positive cells than normal healthy rats. The findings appeared in the July 2007 issue of the Journal *of the Science of Food and Agriculture* (Vol. 87:1753-1757).

On average, the rats on pumpkin supplements experienced a 36% increase in plasma insulin compared to the untreated rats. Prof. Tao emphasized that further research is needed to evaluate the effects in human beings. However, he believes that it could promote regeneration of pancreatic ß cells in humans also. Naturally, blood sugar gets controlled through a hormone called insulin, made by certain pancreatic cells. In type1 diabetes, the body's immune system attacks those pancreatic cells that wreck the insulin-making process, leaving blood sugar uncontrolled, after which insulin shots are required.

Scientists suggest that Asian pumpkin may help to protect those pancreatic cells from the ravages of type1 diabetes and claimed that it could drastically reduce the need for daily insulin injections for millions of diabetics worldwide.

Pumpkin Profile

Pumpkin is a nutritious squash that grows as a gourd in a trailing vine of the genus *Cucurbita* (family Cucurbitaceae). It has about 26 species, the major ones include *C. pepo*, *C. maxima*, *C. mixta*, and *C. moschata*. It is a native of Central America; cultivated in North America, Europe, Australia, New Zealand, India, China and some other countries, but the leading producers are US, Mexico, India and China.

Its name originated from the Greek word *'pepon'* for large melon; the French turned 'pepon' into '*pompon*', the English into *'pumpion'* and the American chose the present name pumpkin. It is a staple food in America where they treasure it both for its dietary as well as medicinal properties. Pumpkin spread throughout the world with the European explorers.

The Plant

The plant grows up to 25 feet long, bearing 3-5 lobed leaves and bright yellow unisexual flowers. The female is distinguished by the small ovary at the base of 5 petals. The flowers are short-lived—as little as one day. The fruits vary greatly in form, but are generally oblong or ovoid and range in weight from less than 0.5 kg to more than 50 kg. The rind is smooth and its colour depends on the species (dark-green, pale-green, orange-yellow and gray are common). Its ability to grow to such a large size makes it the largest fruit in the plant kingdom. The real squash, *C. maxima*, weighs 666 kg.

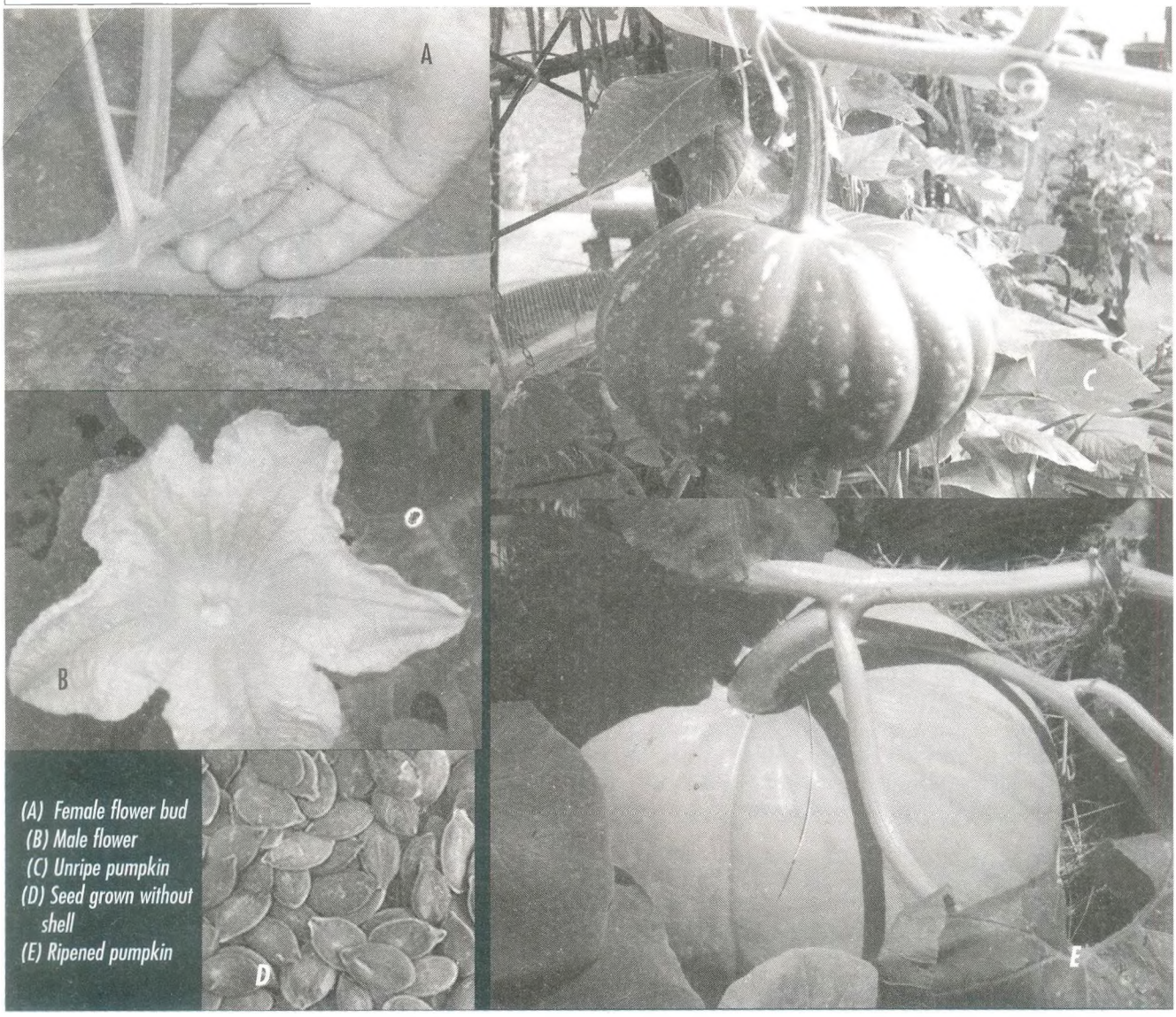
Nutritional Value

Botanically it is a fruit, however in culinary terms, it is widely regarded as a vegetable. It is a popular food that can be eaten boiled, baked, roasted, or mashed into soup or made into various kinds of pie, sweet dishes; the seeds, like sunflower seed can be roasted as a snack. In US they are grown more for decoration and in south India used in worships.

Generally pumpkins are orange in colour because of massive amounts of lutein, the ?- and ß-carotenes, an important antioxidant. The plant carotenoids converted to vitamin A in the body perform many important functions in overall health. They may reduce the risk of certain types of cancer, heart disease, bladder problems, pains and other diseases as well as some degenerative aspects of aging.

1 Cup cooked Pumpkin without salt (245g) contains

Calories 49	Potassium 564 mg
Protein 2 gm	Zinc 1 mg
Total Fat 0.17gm	Selenium 0.50mg
Carbohydrate12gm	Vitamin C 22mg
Dietary Fibre3 gm	Niacin 1 mg
Calcium 37 mg	Folate 21 mcg
Iron 1.4 mg	Vitamin A 2650IU
Magnesium 22 mg	Vitamin E 3 mg
	Cholesterol 0 mg



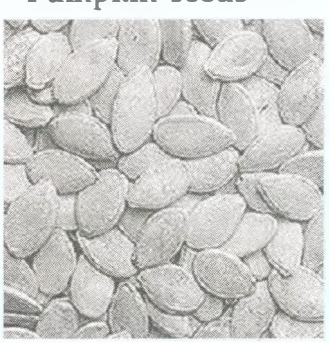
Seeds, also known as *pepitas*, are flat, dark green; encased in a yellow-white husk, seeds of some varieties are without shells, have malleable-chewy texture and delicious subtly sweet nutty flavour. Seeds are rich in fat but good. Like other nuts, pumpkin seeds have a lot of calories and several major groups of active constituents: proteins, fibres, essential fatty acids, amino acids (like, arginine & glutamic), mucilaginous carbohydrates, phytosterols (beta-sitosterol), vitamins and minerals, such as iron, copper, magnesium, manganese, and phosphorous and traces of calcium, potassium, zinc, selenium, folate, and niacin.

A snack on a quarter-cup of pumpkin seeds will provide 46.1% of daily value for magnesium, 28.7% for iron, 52.0% for manganese, 24.0% for copper, 16.9% for protein, 17.1% for zinc.

Pumpkin Oil

Austria is a well-known producer of pumpkin seed oil. Styrian pumpkin seed oil, a power food, is a traditional specialty from the Austrian province of the Steiermark. Due to its high nutritional value, unique taste, and green colour, pumpkin seed oil is often referred to as the 'green gold' of Styria. Pressed from heirloom pumpkins, this rich nutty oil has been a well-kept secret for over two centuries. It is the perfect complement to a wide variety of dishes, as well as a valuable contribution to a healthy diet. It is one of the top nutritional oils, providing an ideal blend of omega-3 and omega-6 fatty acids. It is a delicious alternative to butter and can be drizzled over salads, vegetables, grain dishes, or many other raw or cooked foods. Although it may be used in low-

Pumpkin seeds



Nutritive Value

142 (1oz.) Hulled Seeds
Calories: 153
Protein: 6.9gm
Carbohydrate: 5.05gm
Total Fat: 13gm
Fibre: 1.1gm
Excellent source of Iron: 4.2mg
Good source of Zinc: 2.1mg

Pumpkin farming blossoming (left)
A big happy pumpkin
(an artist's view, above)

temperature cooking, it is highly recommended for use in its raw state, and can be blended in protein drinks, shakes, or smoothies, or just taken plain.

Health Benefits

Pumpkins and their seeds are primarily used in herbal medicine. In some native traditions the blossoms are also used as medicine.

Intestinal Parasites: Due to its use in intestinal infections, the US Pharmacopoeia listed them as an official medicine from 1863 to 1936 for parasite (like tapeworms and roundworms) elimination. Human trials in China have shown to be helpful in acute schistosomiasis, a severe parasitic disease occurring primarily in Asia and Africa that is transmitted through snails. Preliminary human research in China and Russia has shown seeds may also resolve tapeworm infestations. Curcurbitin, a constituent in seeds, has anti-parasitic activity. For parasitic treatment, 200–400 gm seeds are ground and taken with milk and honey, followed by castor oil two hours later. This treatment, however, should be attempted only under medical supervision.

Prostate Health: The carotenoids and omega-3 fats in seeds have potential prostate benefits. Men with higher amounts of carotenoids in their diet have less risk of Benign Prostatic Hyperplasia (BPH). Zinc is another nutrient that might impact prostate function, however, the relationship between zinc and BPH shows mixed results. New studies have shown that they may be beneficial in reducing the risk of some prostate problems since components in pumpkin oil appear to interrupt the triggering of prostate cell multiplication by testosterone and DHT. This has been used in combination with saw palmetto in two double-blind trials to effectively reduce symptoms of BPH. Animal studies have shown that seed extracts can improve the function of the bladder and urethra, this might partially account for BPH symptom relief. It is an excellent source of alpha-linolenic acid that may delay or prevent the development of metastases in breast cancer.

Protection for Bones: Another reason for older men to make zinc-rich foods, such as pumpkin seeds, a regular part of their healthy way of eating, is bone mineral density. Osteoporosis is a problem for older persons, thought often to be a disease for which postmenopausal women are at highest risk. Almost 30% of hip fractures occurring over the age of 50 could be osteoporotic. A study of 400 men ranging in age from 45-92, published in the *American Journal of Clinical Nutrition*, found a clear correlation between low dietary intake of zinc, low blood levels of the trace mineral, and osteoporosis at the hip and spine.

Anti-Inflammatory Benefits in Arthritis: Seeds have anti-inflammatory properties, which help in arthritis treatment. This has been recently investigated in animals comparing favorably with use of the non-steroidal anti-inflammatory drug indomethacin in reducing inflammatory symptoms in respect of arthritis. Importantly, unlike the drug, seeds did not have one extremely unwanted effect: increase in the level of damaged fats (lipid peroxides) in the linings of the joints, a side effect that actually contributes to the progression of arthritis.

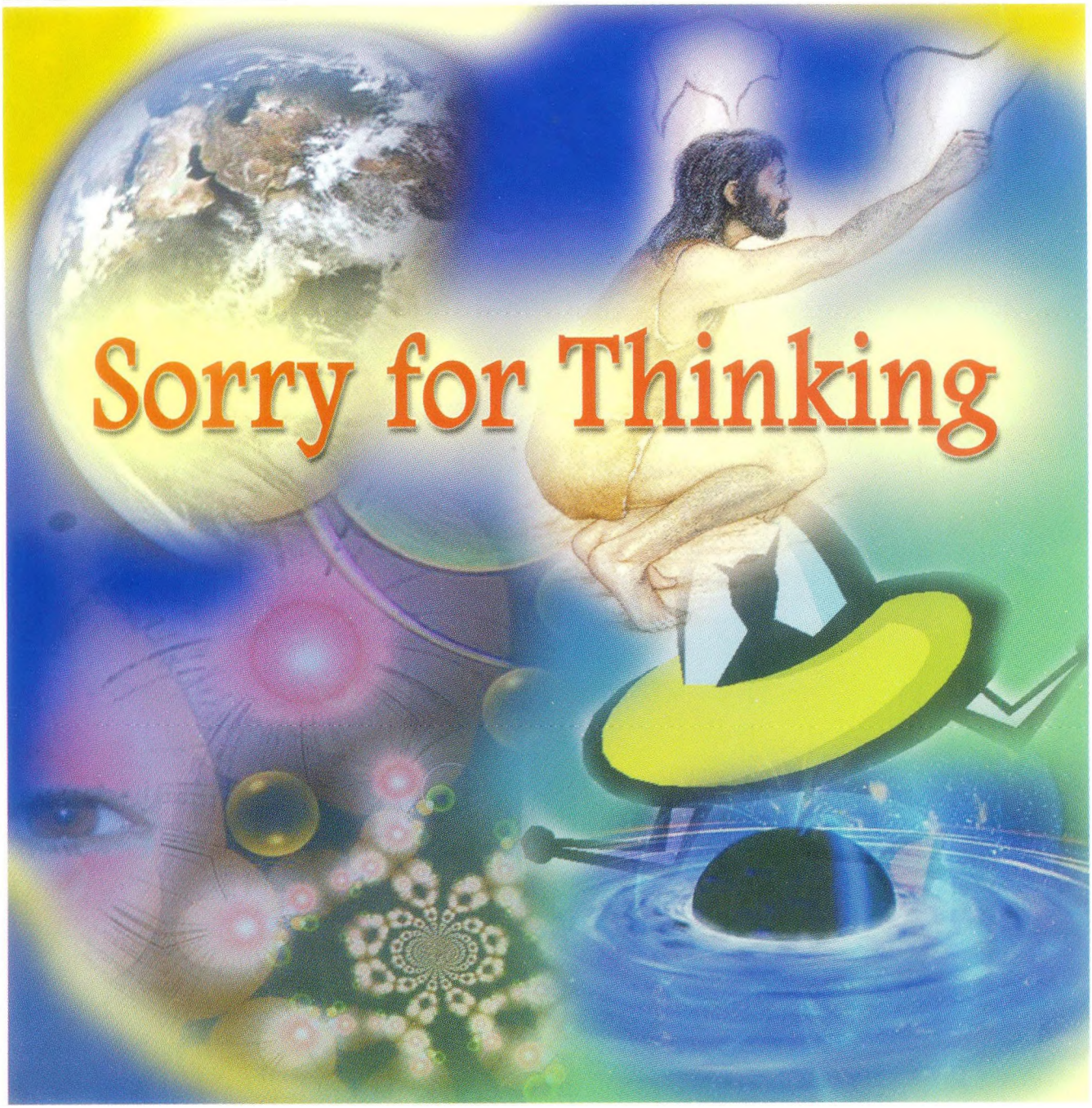
Phytosterols lower Cholesterol: Phytosterols in seeds have a chemical structure very similar to cholesterol, and when present in the diet in sufficient amounts, are believed to reduce the cholesterol level in the blood, enhance the immune response and decrease risk of certain cancers. These effects are so dramatic that phytosterols have been extracted from soybean, corn, and pine tree oil and added to processed foods, such as butter-replacement spreads, which are then touted as cholesterol-lowering foods. But why settle for an imitation "butter" when nuts and seeds are a naturally rich source of phytosterols and cardio-protective fibre, minerals and healthy fats as well? The nuts and seeds typically consumed as snacks and containing phytosterols are: sesame seeds (400-413 mg/100 gm), pistachios and sunflower seeds (270-289 mg/100 g), closely followed by pumpkin seeds (265 mg/100 g) and English walnuts and Brazil nuts (113 mg/100grams and 95 mg/100 gm, respectively).

Depression and Learning: In China, they have been used in the treatment of depression and learning disorders and this may be due to the purported L-tryptophan content.

Urinary tract and Kidney problems: Eclectic physicians (who recommend herbal medicine) in US use them to treat urinary tract and kidney problems and gastritis. Trials in Thailand have reportedly found that seeds can prevent the most common type of kidney stone by reducing levels of substances that promote stone formation and increasing levels of substances that inhibit stone formation. Approximately 5–10 gm per day of seeds may be needed for stone prevention. The active constituents responsible for this action have not been identified.

Pumpkin seeds may cause an upset stomach, but are otherwise extremely safe and commonly not an allergenic food. They are not known to contain measurable amounts of goitrogens, oxalates, or purines. There is no reason to avoid pumpkin seeds during pregnancy or breast-feeding.

Dr S.K. Gupta is Senior Research Officer, Planning Commission, Yojana Bhawan, New Delhi–110001



Sorry for Thinking

MAINAK CHAKRABORTY

I am sorry, you citizens of earth. I'm sorry because I thought what I shouldn't have. It is useless to hide it from you. So I want to tell you about my experience. I had this experience when I was returning to earth after working at the space station for three months. Along with me was my colleague, Sumita.

It was 23rd December 2015. We were almost ready for our flight back to earth. The timer on the countdown-clock indicated that there still was 1 hr and 49 mins left. I was taking some photographs of earth. The earth had never looked so beautiful. The magnificence cannot be described by any literature on earth. Sumita was exploring the galaxy by her telescope. Our spaceship had an air-controller device. So we did not need to wear our spacesuit inside the space ship. It had normal room temperature. We could

I said "Uday, come we will take you to earth now. Leave your space-ship here in its auto mode." Uday hung his head low, and then said unexpectedly, "I don't want to go to earth."

also talk to each other because there was the medium of air. I was now thinking how pollution had taken its toll on earth. I was feeling like a philosopher, contemplating on the ill virtues of man.

It was then that Sumita called me, "Sunny, there is something coming towards earth at a great speed!"

I came near her. I fixed my eyes on the telescope to see an evenly shaped object coming towards us with an unbelievable velocity. Was it a meteor? I froze at this thought. I had read that dinosaurs had become extinct because great-sized meteors had fallen on earth with great velocity. I asked Sumita, "What the Hell is this?"

She answered, "It is not a meteor," as if she had read my thoughts, "It is so evenly shaped and even has a metallic luster."

I was still very worried, but tried hard to hide it. We both were glued to our telescopes. The object, whatever it was, had a velocity of about 6×10^8 ms^{-1}, about the double the speed of light! I could know that because it had covered a distance of 3.6×10^{10} m in one minute! According to scientific reports that I had read, it was impossible for anything, but photons, to have a velocity of light. Then how could something come with double its velocity? I wondered. It was, no doubt, coming towards the earth. But suddenly it changed its direction and started moving in a circular path. Gradually its speed decreased. We both were glued to our telescopes.

In the next few seconds, it had considerably reduced its speed and seemed to be coming towards us. The object was looking as if it was a user-controlled machine. It was far away from us, but we felt as if something was there inside it that was controlling it. The next thought that came to my mind was that of aliens. I had read enough about them in science fiction novels and movies. Now I wanted to see how aliens actually looked like. Still, I had a mortal fear that they might attack us. We two may die here, as we had nothing to defend ourselves. No detective would ever come here to say who, or what, had killed us.

I looked at Sumita. She looked back. She held out her arms as if to hug me. I came near her. I looked into her warm watery eyes. I hugged her. When we looked through our telescopes the next time, the object was standing beside our space ship. At one look, I could say that it was a space ship. It looked like the space ships described by Sir Isaac Asimov in his science-fiction novels. But this was not fiction. It was real life. The space ship had four bright lights that glowed brightly. Then there was a knock on the door of our space ship!

I was thrilled with the thought of meeting aliens. I rushed towards the door when Sumita clasped my hands. I patted her back and said, "I don't see any danger. They seem friendly and peaceful." Without giving her a second glance, I turned the knobs and opened the door.

But what I saw horrified me at first, because it was quite beyond my expectation. It was just another human being (Homo sapiens!). Only in sharp contrast with us was his dress. He was wearing a colourful space suit. Before I could say a word, he walked in and I closed the door behind him.

I told him flatly, "What do you want?"

He told me, "I want friendship with you."

"I was going back to earth. You could have contacted me there, you foolish dolt! Why did you take the trouble of coming all the way from earth for tying the knot of friendship?" I rebuked him.

Sumita quietly said, "Sunny, he didn't come from earth."

I looked at him with a frown. He said, "I am not from earth, I come from Dravidrajya."

Sumita asked, "Where's that?"

"Is that located near Hell?" I joked.

He answered, "I am Uday Kanth. I live in another multiverse. Not here. It is on that side." He pointed towards one side of the vast space.

I questioned, "But multiverses were restricted to our science-fiction stories! What teleported you here from that 'multiverse'?"

Uday answered, "That Black Hole."

"What???" Sumita and I cried out together.

Uday continued calmly, "The Black Holes are the ways to parallel universes, or multiverses." Uday went on, "So, you must be thinking how you and I look similar? Right? Then you must listen to our history. Our evolution from ape-like creatures was the same as yours. Our ancestors lived in present-day India, yes on earth. They were more developed than any other civilization. They had made great advances in science and technology. By the end of 1200 B.C., they had made their own spacecrafts. When Homo sapiens had just evolved to their present form, my ancestors had already learnt to cover their bodies while the Europeans roamed naked in the forests. They were peace-loving people. They were the first to have democracy."

Uday continued, "It was then that a group of humans who had advanced weapons came towards that place. Since my ancestors did not believe in acquiring weapons, as they were peace loving, they started retreating southwards and ultimately when they had nowhere else to go, they went out into space on their self-made spaceships! They did not know where to go for shelter. They roamed in space for months when suddenly one day they felt a great force attracting their spaceships. It was a black hole. Their spaceships went out of their control. They had no idea about black holes. All the passengers started to foresee death. But then they passed safely through the black hole and came to a new multiverse with millions of galaxies. The black hole ejected them out with unbelievable speed—almost double the speed of light! Finally, they reached a planet that seemed to be able to support their lives. They settled there. Their total population then was only four thousand."

I was now trying hard to absorb the facts laid down by him, but still I had the human tendency of not accepting new things readily. So, I said,

The object was looking as if it was a user-controlled machine. It was far away from us, but we felt as if something was there inside it that was controlling it.

"Uday, not all of your ancestors might have escaped from earth? There may still be some left!"

Uday smiled and said, "The scientists first allowed all their family and relatives to fill the space-ships. Then all the important people, like the ministers and their family, filled the seats of the spacecrafts. Then, there was a lottery to determine who would go in the spaceships. There were many unlucky people who could not be accommodated in the spaceships. The capacity of each spaceship was 50 and we had just 80 such space-vehicles. Our ancestors had to leave them here on earth."

"But how did you learn English?" interrupted Sumita.

Uday glanced at us and said, "We have frequently sent our un-manned missions to earth to study it. We came to know that you people widely speak English. So voice-recordings were made from the conversations of earthlings and in this manner we learnt the English language."

"Uday, I am Sunny and this is Sumita. You are cordially invited to earth. Have you come from your planet alone?"

"Yes," he answered, "I have come to earth as a delegate from our planet to make diplomatic relationships with earth."

"That's nice of you. We will take you to earth on our space-ship," I offered. "Well, then tell us about your planet."

Uday took a deep breath and said, "It is true that our planet is not as beautiful as earth. But we love our planet, which has supported us for so many years. We really care for it. You wouldn't find pollution there, not even in traces. Our planet protects us, so we protect her too. The average life span on our planet is 150 years. Diseases are rare. People mostly die because the organs gradually disintegrate and become weak. I am 67 years old. I formally invite you to visit our planet."

"Thank you very much! I would love to go there," I smiled.

"What is the education system in on your planet?" Sumita enquired.

Uday replied, "Our children go to schools where they learn latest technologies. The equations of mass-space-time-energy equivalence are taught at school level. For graduation, a student has to either invent a new device or discover something new, which is still unknown to us. During my graduation I invented a device that could read others' minds!"

I was stunned by all this. Our planet was far behind Uday's planet as far as progress in almost all fields of science was concerned. They were much more developed than us.

Just then an evil plan dawned on me. We could take Uday to earth and force him to reveal to our scientists all about the advances they had made. We could capture him and exploit him for our betterment. With his help we could make advanced technologies possible. Perhaps, many mysteries about space and the universe that our scientists were still wondering about could be explained with his help. First, we would ask for his help. But, if he was not cooperative we could force him. He seemed peaceful, and so perhaps he might not carry any weapon with him. I would also become famous for uniting two worlds. I said "Uday, come we will take you to earth now. Leave your space-ship here in its auto mode."

Uday hung his head low, and then said unexpectedly, "I don't want to go to earth."

I was shocked. All my plans were about to go in vain and along with that, my fame. I knew no one on earth would believe me if I told them that I had met an alien-human in space. I knew that I needed to persuade him anyhow. I said, "You know that the earth is the most beautiful planet. Don't you want to see the magnificent sights that the earth provides? I know you would love to see them. Earth will grandly welcome you. People will be glad to see you. All newspapers headlines will scream 'Two worlds meet after five millenniums!' You will also be able to meet your ancestors on earth." I looked at Sumita indicating her to persuade Uday.

Sumita understood. She said, "Uday, what about your diplomatic relations with earth? You said that you have come here as a delegate from your planet. You wanted to have diplomatic relations with earth. So, why are you now refusing to go with us?"

I took a glance at the countdown-clock, which said that we were to start for earth within twelve minutes.

I said, "See, there are only twelve minutes left for us. Please make up your mind quickly."

Uday went towards the door and opened it. Just then he turned towards us, his head was still hanging low. He said, "Sunny, you are forgetful. Don't you remember that I had invented the device that could read other's minds?"

Saying so, he closed the door of our space ship, swam to his space shuttle and went up, up and away!

Shri Mainak Chakraborty, A/529, Koel Nagar, Rourkela

"Reservation in Higher Education will help Transform Indian Society"

Adverse Impact

Despite the rapid and massive growth of higher education, India has only about 10 to 11 percent of its relevant age group enrolled for higher education, as against 55-95 percent in developed countries. If the dropout and survival rates, and the literacy and illiteracy rates of the broad social categories are any indication, India has not done much for democratisation of access even at the primary and elementary level. How does admitting a few students through reservation in institutes help the community? Without limiting the advantage given to reserved groups, reservation will have an adverse impact on the quality of higher education.

Dr. Shiva Darshan Mehta
IGNOU, Delhi

Criteria Should Be Changed

Before independence, the backward castes were deprived of education; so reservation was required. But the time has changed now. The population of India has risen above 102 crore. The seats for higher education in universities and colleges are limited, so it will be foolishness to deprive the better brains for further education just because of their castes. In my view criteria should be changed and must be on the basis of one's financial status.

Basant Kumar Tiwari
Naini, Allahabad

It is their Right

As the people belonging to far-flung and economically backward areas do not have as much facilities as the others have, it is their right to get reservation in higher education to maintain a balance in distribution of posts among various sections of society.

Parvez Lone
J&K

Create Equality

Merit is not reserved for specific

category of students. Admission should be on 'competency basis'. Universities and Institutions should not create Casteism.

Kavyashree K.V.
Karnataka

Reservations Not the Criteria

Certainly reservations are not the criteria to serve the needs of a country like India to transform it into a sophisticated society in the aspect of higher education.

Reservations should demarcate the people only by means of economy and not in any other faculties. Giving reservations en masse irrespective of monetary status (even to well-to-do-people) may put hurdles in the lives of people struggling to come up only by means of intellect and intelligence? To transform Indian society in the aspect of higher education, there is every need to provide reservations to backward classes only and to the people of BPL (Below Poverty Line).

P. Srivatsa
Andhra Pradesh

All are Equal Before Law

Reservations in higher education will not help to transform the Indian society rather it will deplete the Indian society. In our country it is

observed that a person getting more than 80% marks does not get admission while a person with less than 50% marks gets admission by showing a caste certificate. In the preamble of our Constitution it is mentioned that all are equal before law, then why our country discriminates between castes? If this continues in future then India will never be called a developed nation. A child should be given admission in higher education only if he/she is eligible, not on the basis of caste.

Rik Chatterjee
GAIL, Vijaipur (M.P.)

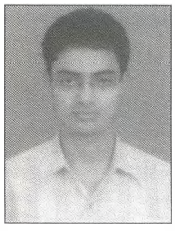
Doom's Day is near

Indeed, reservations will pave the way for a new Indian society. The reserved class will get admission in different academic field without facing the heat of cutthroat competition. Consequently the standard of education will go down. This will be detrimental for future India as the really deserving section is kept out. The best brains not getting what they actually deserve will have to compromise with anything they get. As a whole the quality of society will not be up to the mark and so we will always remain a developing country not a developed one. The government should look after quality of education provided to children both in cities and in villages and raise the standard of education. They should improve at grass root level and help the poor section of society financially, so that each individual gets proper education. When everyone is on the same platform then there should be open competition so that only the deserving get the chance to study in colleges and universities and guide India to become a developed nation.

Gaurav Kumar
Bihar

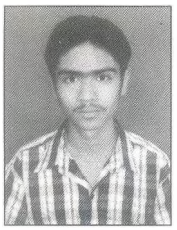
Talent Should be the Criteria

Reservation is only helpful when



it reaches needy persons. To ensure this, the basis of reservation in higher education should be talent as well as economic level, not caste and religion. Reservation in higher education should not be made a political issue.

Dhananjay
Bihar



Review Frequently

It's true that certain sections of society need a helping hand but widening of reservation ambit won't work. Reservation plays a vital role in upliftment of people of lower strata through education but this reservation policy should be reviewed frequently. The profited ones should not be given a chance to benefit from this policy again and again. Slowly and silently this policy should disappear. Steps should be taken to weed out those who have outgrown the need of reservation. Unless this happens, the reservation policy would outlive its usefulness.

Abhinav Kumar
Patna

Reservation Vs Quality

According to me it is not reservation but improvement in quality of education and its availability in villages and backward areas that will help in transformation of the Indian society. A building is strong only when its plinth is strong.

Barooj Ali Heshi
GVEI

Not the Right Way

No doubt there has been social injustice for a majority of the people in our country. It has to be set right. We already have reservations for scheduled castes (SCs) and Scheduled Tribes (STs). Expanding it is not the right solution. Reservation is not the right way to move forward. The politicians are just trying again to divide the castes further in the name of

reservation. And yet we have the temerity to harp on 'Unity in Diversity'. Whither Unity? With what mind are we flooding every page of school textbooks with this meaningless phrase "Unity in Diversity".

Mohd Rizwan Idrisi
Shahjahanpur

Blinkered View

The education scenario of our country in present times is highly diluted in spite of quantitative progress (cf literacy rate 65.5%, over 350 universities, 17600 colleges, 1,124 million schools). India is lagging behind in science and technological development as compared to the counterparts. Gone are the days when Indian education produced great personalities like Dr Homi J Bhabha, Dr Vikram Sarabhai, S.N. Bose, C.V. Raman, and M.K. Gandhi to name a few but the present education scenario of our country is afflicted with several problems where quality of education is being severely compromised. While we are failing to monitor quality in the ever changing world rocked by knowledge explosion and IT revolution, we should not try to further degrade it through allowing poor quality students to India's premier institutes like the IIT, AIIMS, IIMS and all central universities.

World Bank researcher Karia Hoff and Pennsylvania State University's Priyanka Pandey's study reveals that: "Reserved tag and over emphasis on caste makes the beneficiaries of reservation less motivated and lowers their self confidence as they expect the social pressure to act against them." Further, according to IIT Delhi's Students Review Committee (SRC) most of the reserved category students are unable to withstand the pressure of the course and opt for change in discipline and even take extra two years to complete the course.

If the government is thinking seriously of uplifting the backward class people it may go for alternative ways such as through positive affirmation as enshrined in our 1951 constitutional amendment. It may be through issuing vouchers to the needy, increasing scholarships at school level and tertiary level, strengthening vocational education in our country and stopping corruption in distributing NTSE scholarships. The time has came for all of us to think whether to serve half of the nation through reservation/other considerations or the entire nation on the basis of merit.

As per the present global context, merit can lead our country to become truly global, not reservations.

Bibhuti Narayan Biswal
Gujarat

Effect on Higher Education Quality

Reservation in higher education will not help transform Indian

society, because this type of reservation policy will help only to develop backward society and it will also have a bad effect on the standard of higher education. Therefore, this is not the solution to transform Indian society. But if it is on the basis of economic level then it will be helpful in transforming the Indian society.

Chandan Kumar Jha
Bihar

Strengthening Caste Feelings

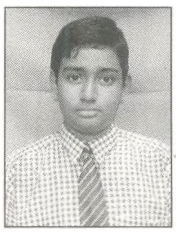
When modern society is striving for equality, reservations in higher education are strengthening caste feelings in the youth. They develop hatred towards other castes, which is very hazardous. Free and compulsory education unto 14 years for every child is the right provided by the constitution. A child educated up to 14 years can very well pursue higher education based on his intelligence rather than on reservations. Moreover intelligence is not based on caste or religion. Reservations instead of transforming the Indian society towards progress will shatter it into pieces.

A. Blandina John
Hyderabad, A.P.

All are Equal

The roots of this question go deep into the Vedic age. In the rig Vedic age, there was social equality among the people. The early Aryans believed in "talma mashi " meaning "You are in me". But with the advent of the later Vedic age, the society was divided on the basis of work done by the people, into four classes or "Varna-Ashramas". Now when birth determined the caste, the society reflected a very complex form. The three higher castes started exploiting the lower caste. These lower castes were deprived of both educational as well as spiritual activities.

After Independence, reservation in the educational institutes has helped in raising the level of the scheduled castes and scheduled tribes to the level of the so-called higher classes. But reservation in higher educations has created a lot of trouble. The constitution of India, in the chapter III dealing with the Fundamental Rights states that there should be no discrimination in higher educational institutes on the basis of caste, colour or creed.



It is completely unjust for the young generation who never believes or practice caste system to suffer from discrimination on the basis of caste. It is a fact that the meritorious unreserved students are burning with anger against the policy of reservation in higher education. It is judiciable to help the poor and backward classes but reservations in higher education should not be on the basis of caste.

Abhijeet Patnaik
Orissa

Reservation in Higher Education Increaseas Unemployment

I think, seat reservation in higher education, especially in the institution of specialised fields like administration, engineering and medical line, would bring down the level of the institutions. Due to the seat reservation many students who get poor marks, get admission very easily due to the caste facility. Not only this, it decreases the employment level of the society as good students are not able to get admission and remain unemployed for many more years. In such circumstances, public can not trust doctors, managers etc.

The reservation in higher education should not be kept at all.

Barnakshi Saha
West Bengal

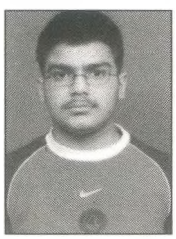
Of Course Required

Higher education is seems to be a dream to students who are from non-urban area. Though rural students have the same knowledge and ability as that of urban students, They couldn't get into higher education institutions as lacking of basic facilities and diverse exposures. Villages are backbone of India so Reservations in Higher Education will help in upliftment of rural students as well as rural area and so it will help transform Indian Society.

Logeswari
Tamil Nadu

Putting Cart Before the Horse

The present Govt is very keen to provide reservations in Higher Education to the SC's/ST's and OBC's. There is no doubt that



the Indian Constitution provides for reservations for such backward classes but the purpose was to provide these only for a limited period until these categories of people ameliorated their socio-economic conditions and could stand on their own legs. But sixty years have elapsed since we got Independence, we find only a small percentage of these people have reached a state of 'creamy layer' and the majority continue to languish behind educationally as well as economically. These reservations have become a permanent feature of our Govt policy. What was actually needed was to provide 'free and compulsory education' to all the children in the age group of 6-14 by the end of 1960 as per the Constitution but even when we have entered the 21st century this goal has remained a pipe dream. The overall percentage of literacy in this age group has not reached even 75% and the position of girls, education is still worse. And what about the backward castes – their illiteracy rate is still higher. Providing reservations in higher education to these classes of people is more out of political motivation than a balanced rational academic logic. Right now providing reservation in higher education amounts to putting the cart before the horse. The recipient clientele is not yet ready to harness the benefits of such a policy. They have still miles to go before they can really benefit by it. At present these benefits will be grabbed by only those who have already reached a state of 'creamy layer'. Of course political parties can blackmail the emotions of these poor people for getting enough votes. Unless the base at school education level is improved quantitatively as well as qualitatively we cannot hope to transform the Indian society. Till now the Govt has not been able to convince the Supreme Court of the sound educational rationale and social ethics of its present reservation policy.

Vaibhav Kaul
Jaipur

Now write in your thoughts on this topic for inclusion in the forthcoming issues:

"The nuclear deal with the US will be beneficial for India."

Be brief and be logical! Send in your photo, if you like.

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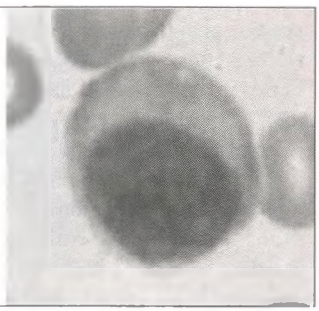
Your Immune System

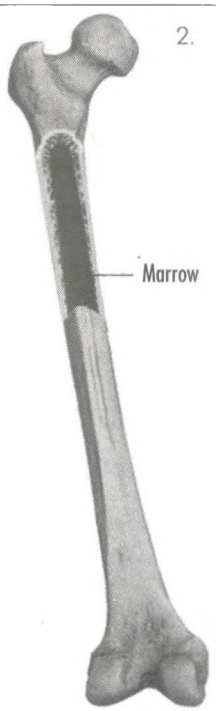
SANJAY SUMAN

Find out how much you know about the human immune system

1. Antibody is produced by:
   a) B Lymphocytes
   b) T Lymphocytes
   c) RBC
   d) WBC

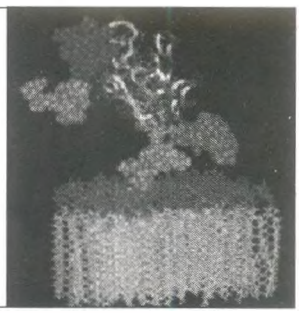


2. B Lymphocytes are produced in:
   a) Bone marrow
   b) Thymus
   c) Liver
   d) Kidney

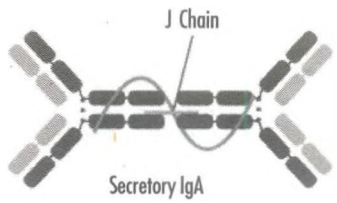


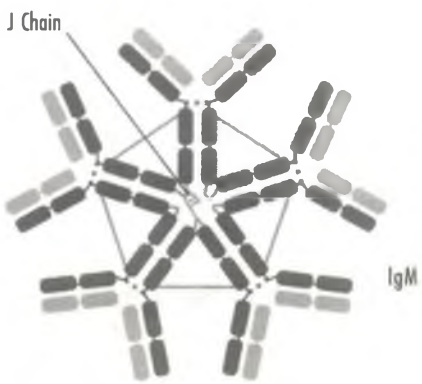
3. Maturation of T lymphocytes occurs in:
   a) Bone marrow
   b) Thymus
   c) Liver
   d) Kidney

4. Antibody is made up of:
   a) Glycolipid
   b) Lipoprotein
   c) Lipid
   d) Glycoprotein

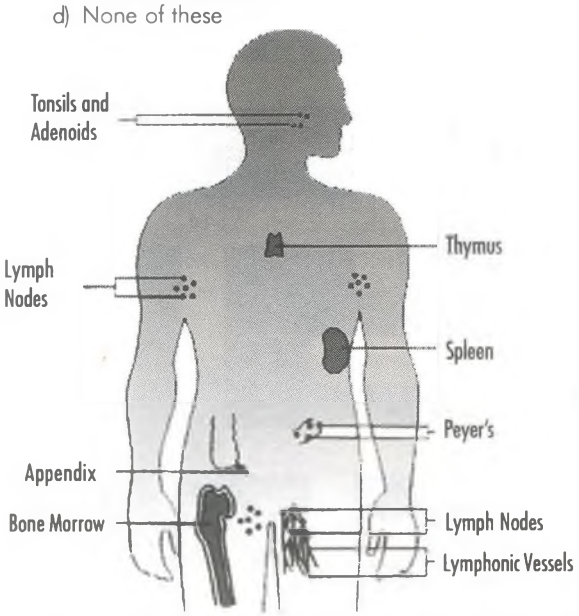


5. Antibody is subclassified into:
   a) Five types
   b) Four types
   c) Three types
   d) Ten types





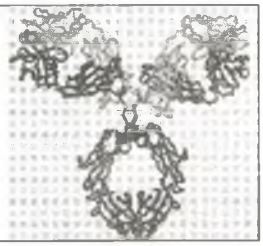
6. Immunology is the study of:
   a) Immune system
   b) Nervous system
   c) Respiratory system
   d) None of these



7. Our defence mechanism consists of:
   a) Innate immunity b) Adaptive immunity
   c) Both d) None of these

8. Adaptive immunity consists of:
   a) Humoral immunity b) Cell mediated immunity
   c) Both d) None of these

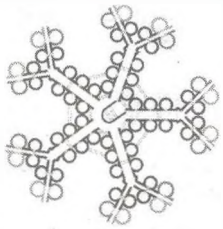
9. Which of the following is found in secretory fluids:
   a) Ig M
   a) Ig E
   b) Ig D
   c) Ig A



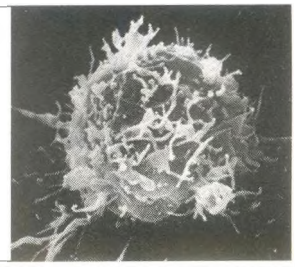
10. Allergic response is mediated by:
   a) Ig M b) Ig E
   c) Ig D d) Ig A

11. Which of the following crosses placenta:
   a) Ig G
   b) Ig E
   c) Ig A
   d) Ig M

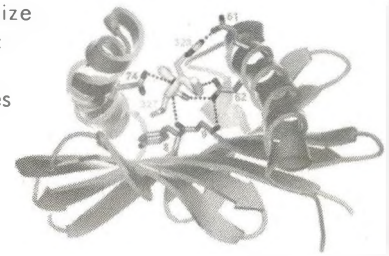
12. Secreted form of Ig M is:
   a) Monomer
   b) Dimer
   c) Trimer
   d) Pentamer



13. Cell mediated immunity is associated with:
   a) B lymphocytes
   b) T lymphocytes
   c) Both
   d) None of these

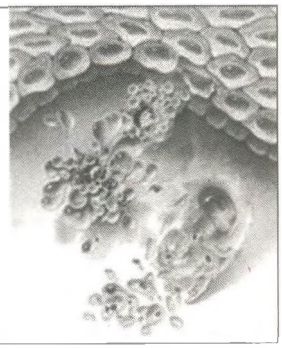


14. T cells recognize antigen with the help of:
   a) MHC molecules
   b) RBC
   c) WBC
   d) Platelets

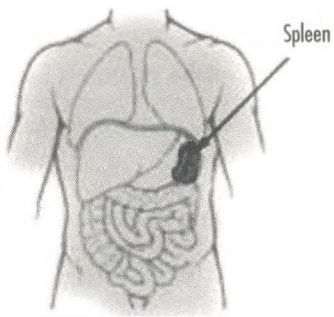


15. Memory is the characteristic of:
   a) Innate immunity
   b) Adaptive immunity
   c) Both
   d) None of these

16. The term 'apoptosis' means:
   a) Cell death
   b) Cell division
   c) Both
   d) None of these



17. Blood borne antigen is transported to:
   a) Lymph node
   b) Spleen
   c) Heart
   d) Neuron



ANSWERS:

1.a	2.a	3.b	4.d	5.a	6.a
7.c	8.c	9.d	10.b	11.a	12.d
13.b	14.a	15.b	16.a	17.b	

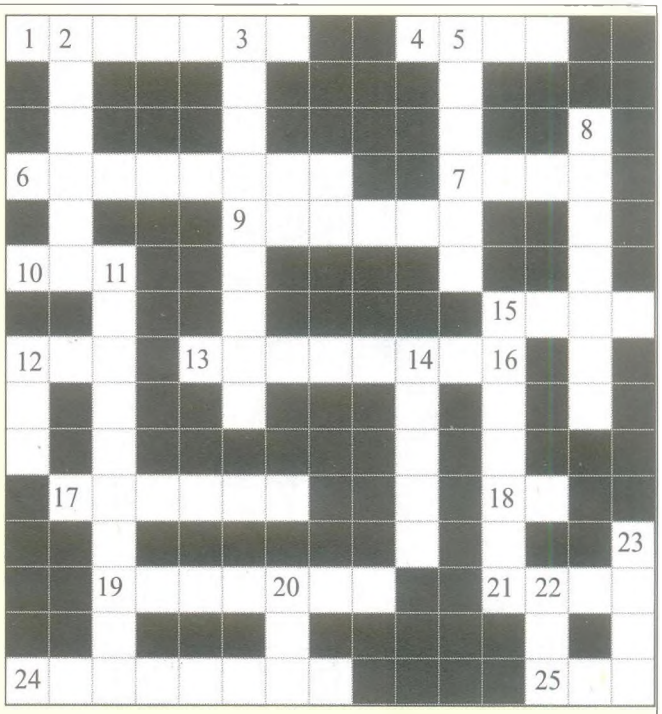
Contributed by Shri Sanjay Suman, S/o Indradeo Mahto, Vill&Post- Tetarhat, Dist-Lakhisarai, Bihar-811311

ACROSS

1. A nitrogenous base of RNA (7)
4. A noble gas with atomic number 10 (4)
6. Study of fruits (8)
7. Genus of rose (4)
9. It has burning taste (6)
10. Hind limbs of humans (3)
15. Part of shoot system having branches (4)
12. A system of measurement named after centimeter, gram and second (3)
13. An alkali metal of period 7 and with lowest known electronegativity (8)
17. A property of metals (6)
18. Symbol of tin (2)
19. Nitrogen and hydrogen react to form this gas (7)
21. This technology is very popular these days (4)
24. A force that opposes the motion of a body (8)
25. These diagrams are used in statistical analysis (3)

DOWN

2. A pentose sugar (6)
3. One of the structures found in vertebral embryos (9)
5. Fertilised eggs contain... (6)
8. A line that touches a circle at one point (7)
11. A stage of human embryonic development (8)
12. Most common germ carrier (3)
14. Country having largest cattle population (5)
16. A muscle protein (6)
20. Means modern (3)
22. Stores energy in the form of phosphate bonds (3)
23. A very stiff connective tissue (4)



Contributed by Shri Sahil Sharma, S/o Shri R.L. Sharma, R/o Ward no 02, Sunderbani, Distt. Rajouri, J&K 185153

Solution will be published in the next issue

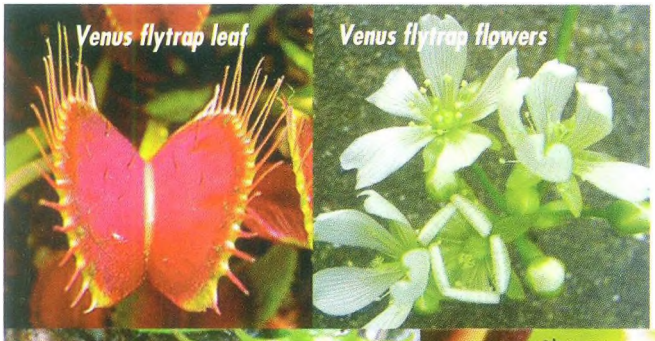
Solution to Crossword December 2007 issue

P	H	O	T	O	S	Y	N	T	H	E	S	I	S	
H		I			O		O			C			U	
Y	O	L	K		L		I	N	C	H		A	R	C
S			I		A		S			O			F	
I	R	O	N		R		E	A	R		C	O	A	L
C			E		C						O		C	
S	Y	N	T	H	E	T	I	C	F	I	B	R	E	
	E		I		L		R				O		T	
N	A		C	E	L	S	I	U	S		L		E	
	R		E				S		I	N			N	P
A			N		L				E				S	
I	N	T	E	G	E	R			M	A	T	R	I	X
D			R	A	D	O	N		E		I		O	
S	M	O	G						N		N	A	N	D
		C	Y	T	O	P	L	A	S	M				C

Mysterious Venus Flytrap

"There is no excellent beauty that has not some strangeness in the proportion." - *Francis Bacon*

THIS is also true for plants and Venus Flytrap is a good example. The Venus Flytrap (*Dionaea muscipula*) is a carnivorous plant that catches and digests animal prey. There are several stories of how the Venus Flytrap got its name. It is said that the plant's name refers to Venus (daughter of Dione), the Roman mythical goddess of love and beauty. In 1770, in London, merchant and botanist John Ellis published the first description of a new sensitive plant, *Dionaea muscipula* or Venus flytrap. Because the traps of a Flytrap resemble clamshells, and they are found growing along the coastal range of North Carolina, people in the region thought it cute to name it Venus Flytrap.



This is one of a very small group of plants that are capable of rapid movement. As adult plants, Venus Flytraps grow to 6 inches in diameter with traps measuring up to 1.5 inches (3.8 cm) at the most. Spikes protruding from the edges of the leaf form a narrow cage for the insect. The trapping structure is formed by the terminal portion of each of the plant's leaves.The leaf swells to close the gap and secretes a fluid that digests the insect in about ten days. Then the leaf grows a little and opens up, ready for the next visitor.

The leaves of Venus Flytrap open wide and on them are short, stiff hairs called triggers or sensitive hairs. When anything touches these hairs enough to bend them, the two lobes of the leaves snap shut trapping whatever is inside. The trap will shut in less than a second. The trap stays open for a few seconds in order to allow very small insects to escape because they wouldn't provide enough food. If the object isn't food, e.g., a stone, or a nut, the trap will reopen in about twelve hours and 'spit' it out. The mechanism of closing has fascinated biologists for many years. How can an inanimate plant react so quickly to the stimulus of touch? The most widely accepted explanation had been that a rapid change in the turgidity of the cells occurs.

There are several varieties of the Venus Flytrap. A common variety that is found in many nurseries is the Dente Flytrap, which has shorter and more pronounced teeth. A variety that is gradually becoming available is the Red Dragon Flytrap, which turns completely red when grown in full sun. Other varieties that are slowly making their way into the market are the Royal Red, Red Piranha, Paradise, Giant and Sawtooth. A variety that is very popular among growers is Big Mouth. Its traps have been reported to get up to 2 inches (5 cm) long. Although genetics play a role, the growth of large traps is heavily dependent on optimal growing conditions.

EXCITING SPACE WALK!

Extra-vehicular activity (EVA), more commonly known as space walk, is when astronauts venture out of the spacecraft in space to perform some work. The term also applies to an EVA made on the surface of the Moon (a *moonwalk*).

The American and Soviet space programs define an EVA differently. Russians define an EVA as occurring when a cosmonaut is in a vacuum. An American astronaut EVA begins when the astronaut switches the Extravehicular Mobility Unit (EMU) to battery power. The term stand-up EVA (SEVA) is used for being partly outside.

EVAs may be either tethered (the astronaut is connected to the spacecraft, oxygen can be supplied through a tube, no propulsion is needed to return to the spacecraft) or untethered. When the tether performs life support functions such as providing oxygen, it is called an *umbilical*. For untethered EVAs during space flight, capability of returning to the spacecraft is essential

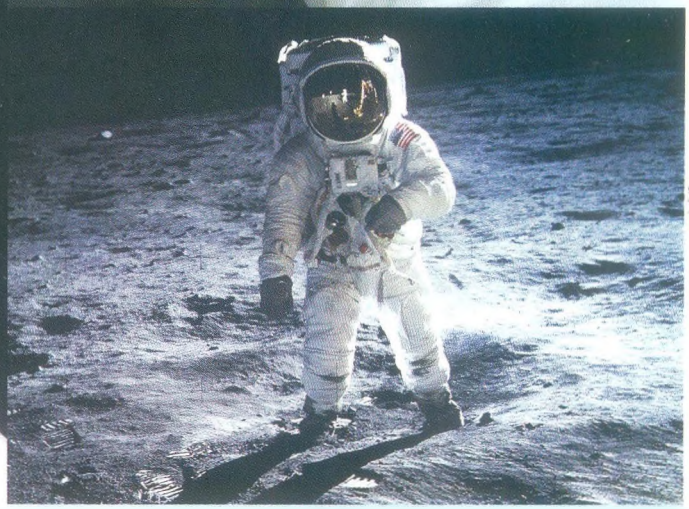
EVA Milestones

- The first EVA was carried out by Aleksei Leonov on March 18, 1965 from the Voskhod 2 spacecraft.
- The first EVA that was a moonwalk rather than a spacewalk was made by American astronaut Neil Armstrong on July 20, 1969 when the Apollo 11 Lunar Module *Eagle* landed on the Moon. He was joined by crewmate Buzz Aldrin, and their EVA lasted 2 hours and 32 minutes.
- The first untethered spacewalk was by American astronaut Bruce McCandless II on February 7, 1984, during *Challenger* mission STS-41-B.
- The first woman to perform an EVA was Cosmonaut Svetlana Savitskaya on July 25, 1984 while aboard the Salyut 7 space station.
- The first EVA to perform an in-flight repair of the Space Shuttle was by American astronaut Steve Robinson on August 3, 2005, during "Return to Flight" mission STS-114. Robinson was sent to remove two protruding gap fillers on the Space Shuttle *Discovery*'s heat shield, after engineers determined they might cause damage to the shuttle upon re-entry.
- The longest EVA was 8 hours and 56 minutes, performed by Susan J. Helms on March 11, 2001.
- Anatoly Solovyev, with 16 spacewalks, totaling 77 hours, 41 minutes EVA, holds the records for most spacewalks and greatest duration on EVA.

Top: Backdropped by a colourful Earth, astronaut Robert L. Curbeam, Jr. (left) and European Space Agency (ESA) astronaut Christer Fuglesang, both STS-116 mission specialists, participate in the mission's first of three planned sessions of extravehicular activity (EVA) as construction resumes on the International Space Station.

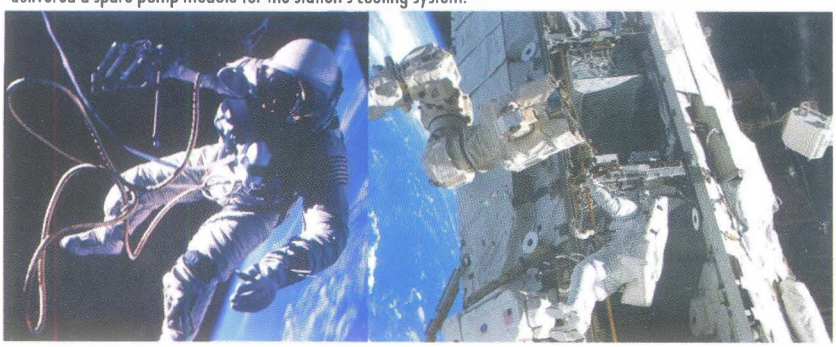
Above: Astronaut Bruce McCandless II, mission specialist, participates in an EVA, a few meters away from the cabin of the shuttle Challenger. He is using a nitrogen-propelled hand-controlled manned maneuvering unit (MMU). He is performing this EVA without being tethered to the shuttle.

Anchored to a foot restraint on the International Space Station's robotic arm, STS-114 Mission Specialist Steve Robinson participates in the mission's third spacewalk.



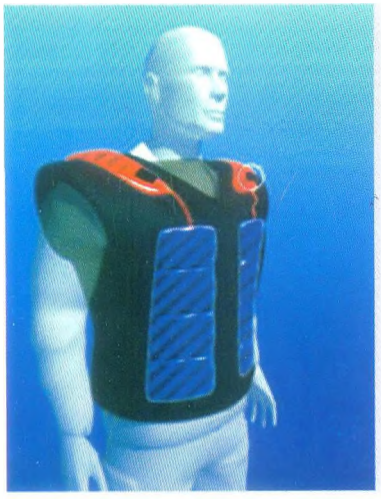
Top: View of an apparent hole found in a glove of astronaut Rick Mastracchio during the third EVA of Mission STS-118. The two astronauts floating outside the International Space Station were forced to cut short the EVA.
Above: The first lunar walk.

Blow left: Edward White made the first U.S. spacewalk. Tethered to his Gemini IV capsule, White is pictured holding a compressed gas "zip gun" for maneuvers in his right hand.
Below right: During a six-hour 47-minute spacewalk, astronauts Sellers and Fossum restored the International Space Station's Mobile Transporter rail car to full operation and delivered a spare pump module for the station's cooling system.



EVA Hazards

- Collision with space debris. Orbital velocity at 300 km above the Earth is 7.7 km/s. This is 10 times the speed of a bullet, so the kinetic energy of a small particle with a mass 1/100th that of a bullet (e.g. a fleck of paint or a grain of sand) is equal to that of a bullet.
- Hard to simulate. External environments in space are harder to simulate before the mission, though approximate simulations can be achieved. EVAs are often planned late in the project development when problems are discovered, or sometimes even during an operational mission. The exceptional danger involved in EVAs inevitably leads to emotional pressures on astronauts.
- Separation from craft. A space walker could become separated from his or her craft.
- Spacesuit puncture. This would depressurize the suit, causing anoxia or deprivation of oxygen and rapid death if the space walker is not brought into a pressurized spacecraft quickly.
- Overinflation. During an EVA, Aleksei Leonov's suit became overinflated to the point he could no longer re-enter and seal the door of the airlock. Because he was breathing pure oxygen, he was able to reduce his suit pressure to under 4 psi (28 kPa) and, with much effort and climb back inside.



Power Jacket to Charge Portable Devices

The Power Jacket, developed by an Australian corporation, Commonwealth Scientific and Industrial Research Organization, not only protects but is also capable of charging portable electronics. The Integrated Energy Device is intended to self-generate electrical energy, which in turn powers the wearer's devices without a power plug and cord. The jacket will be a breath of fresh air, for hill walkers. The jacket works by transforming the motions and movements of the body, and channelling these vibrations to form electrical energy from kinetic energy

Now Mobile Payments

After the launching of Nokia 6131 NFC, users will be able to use it to buy coffee, exchange business cards, and collect data with a single push of a button. That's because the 6131 NFC has a long-awaited technology called near field communication, which allows two devices to transfer money or swap information. The 6131 NFC also has a built-in MP3 player and camera, among other standard features. So, Goodbye cash, hello mobile payments!

Wrist Blood Pressure Monitor

About one in every four adults has high blood pressure. High blood pressure is especially dangerous because it often gives no warning signs or symptoms. Consistent monitoring of your blood pressure will keep you and your doctor informed of your progress. Do-it-yourself Wrist Blood Pressure Monitors make it easy and convenient for individuals to test themselves. This is compact and lightweight and easy to use.

Camera Recognises your Smile

This one clicks only when it recognises a smile, never taking a depressing photo. After the first recognition software in cameras that allowed faces to be automatically detected, the latest offering is smile recognition. Smile recognition captures the perfect photograph. Once a smile is recognised the shutter clicks and a photo is taken. Amazingly, the user can manually set different degrees of smiles.

Say cheese and snap one up soon!

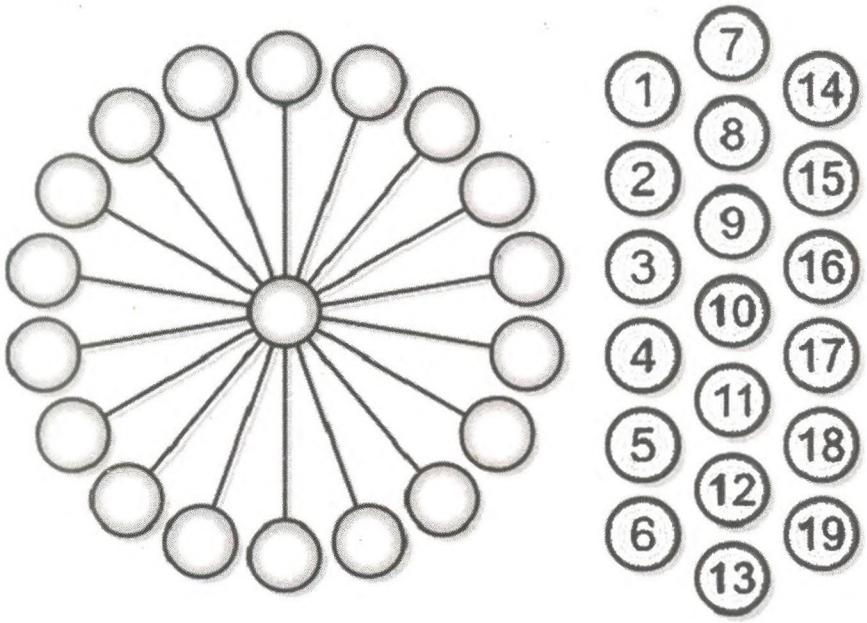
Ultra Mobile Portable Computer

Mini-PCs are supposed to be the next big thing in computing. Seamless Internet's new mini-PC has an 8-hour battery life and a fold-out keyboard meant to silence two key criticisms of these ultra small computers: power drain and dumb thumb. Other features include Wi-Fi, Bluetooth and tri-band cellular technology plus an Intel PXA 270 Xscale 520 MHz processor, 256MB of RAM, a 20GB hard drive, and Microsoft Windows CE 5.0.

ALIGNING CIRCLES

Prize Puzzle

Write the numbers from 1 through 19 in the circles so that the numbers in every 3 circles on a straight line total 30.



There are three prizes for three correct entries. In case there are a large number of correct entries, the prize winner will be selected through a draw of lots. The decision of the Editor, *Science Reporter*, will be final. Fill up and mail your entries to:

Puzzle Corner
Science Reporter
National Institute of Science Communication And
Information Resources, CSIR, Dr. K.S. Krishnan Marg
New Delhi-110012

Last date for the entries to reach us: 05-02-2008

Frist Prize : Cash prize of Rs. 200/-
Second Prize : Cash prize of Rs. 150/-
Third Prize : Cash prize of Rs. 100/-

Your Name : .....
Address : .....
.....
..... Pin Code : .....
Age : ..... Sex : .....

Occupation : ☐ Student ☐ Housewife ☐ Teacher ☐ Professional ☐ Retired ☐ Other

Educational Level: ☐ Secondary ☐ Graduate ☐ Postgraduate

*please fill up the questionnaire at the back

GERMAN NOBEL LAUREATES IN PHYSICS

In this puzzle, there are names of 11 Nobel Prize winners in Physics, who were Germans or of German origin. All, except one, were winners upto 1925. The one exception died recently at the age of 94. Further, when all 11 names are struck out, 20 letters will remain, which will read sequentially, the full name of the Physics laureate who shared it with his father (7,8,5).

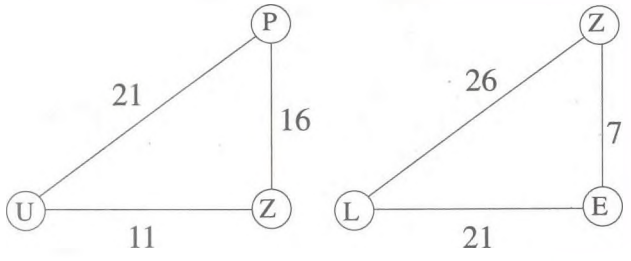
E	H	T	E	B	W	K	I	L
R	L	F	I	N	R	A	E	M
D	O	L	R	A	E	I	A	W
R	R	N	T	A	N	I	K	H
A	B	S	T	S	N	C	W	E
N	E	R	T	G	N	C	E	R
E	N	E	A	A	E	U	K	T
L	I	C	L	U	A	N	E	Z
N	B	P	R	L	N	A	G	G

Contributed by M. Ratna Prabhu, B-11, Sterling Apts, Part I, Nr. Taleem & ICECD, Bopal, Ahmedabad-380 058

Solutions to the puzzles published in the November 2007 issue:

Prize Puzzle: Position Puzzle

Sides have numbers 5 less than the position value of the letter in English alphabet that is there on the opposite circle of the sides. For example, in the first triangle, the circle with letter 'p' has got an opposite with a value 11, which is 5 less than the position value of 'P' (P's position value in English alphabet is 16). If position value somewhere comes less than 6, then backward journey from 'Z' is taken in to the pattern, as it happens with 'E' in 2nd triangle to the right. 26 is 'Z's' position value in English alphabet which is coming since E's position value is 5.



Astronomical Objects

ALDEBARAN	ARCTURUS	BETELGUESE
CAPELLA	PLEIADES	REGULUS
SIRIUS	SPICA	POLARIS
VEGA	MOON	EARTH
VENUS	MARS	JUPITER
CERES	LEO	TAURUS
GEMINI	ORION	

The Prizewinners of the November 2007 issue are:

First Prize:
Snejuti Biswas, Nabadwip, Bakutalla Balika Vidyalaya, PO Nabadwip, Dist. Nadia (WB)-741302

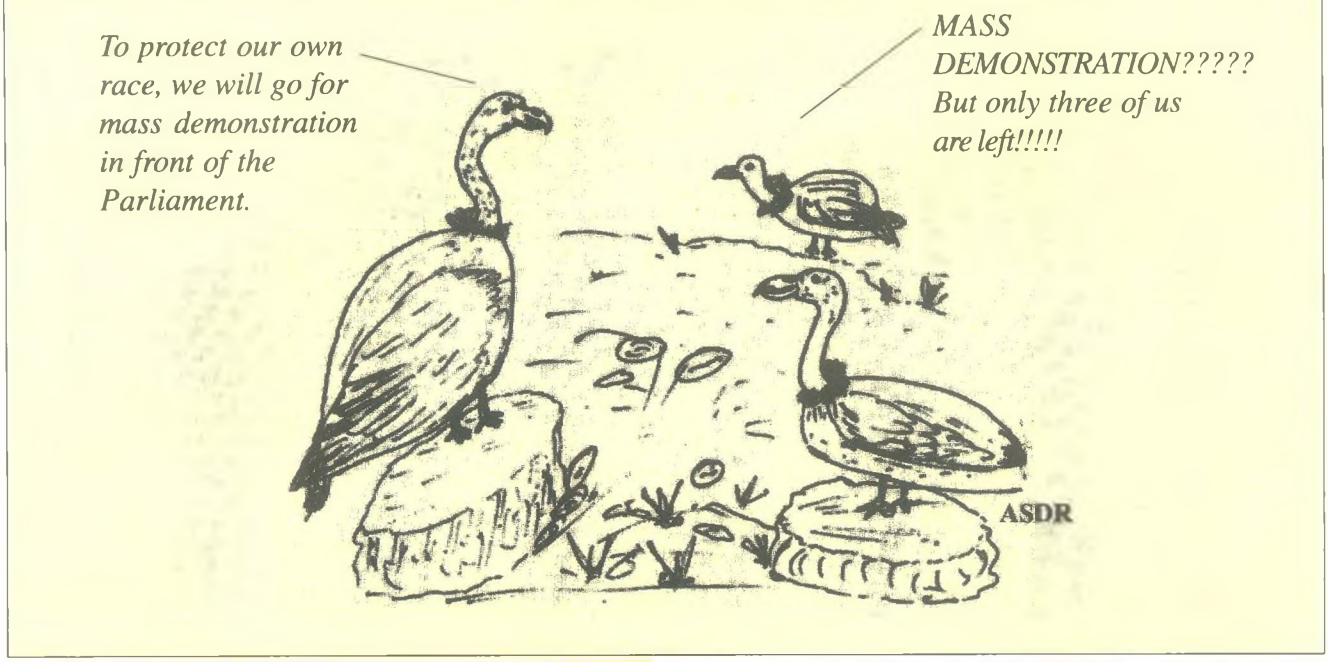
Second Prize:
Lalatendu Panda, S/o Saroj Kumar Panda, At PO Purna Balasore, Dist. Balasore Orissa

Third Prize:
Anju Gupta, C/o Shri RN Gupta, Gandhi Nagar (West), Second Lane, Hazaribagh-825301

CARTOON by

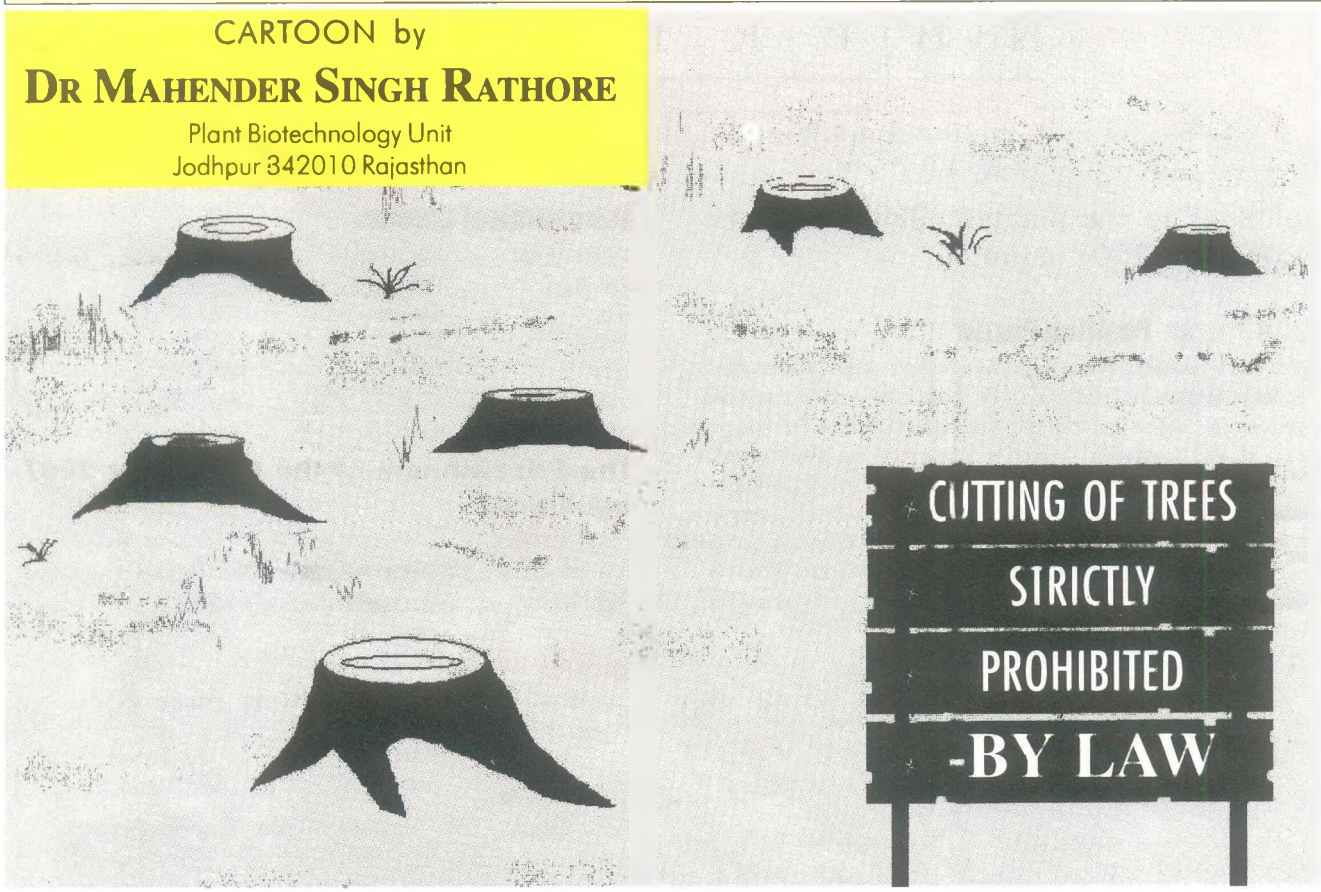
SHRI ABHAY S D RAJPUT
VPO Pragwal, Teh. Akhnoor
Distt Jammu

Lack of habitat and food, vet drug diclofenac and perhaps a viral disease are killing the three Gyps vulture species. Their population is dead more than 97% and are now on the verge of extinction.


To protect our own race, we will go for mass demonstration in front of the Parliament.
MASS DEMONSTRATION????? But only three of us are left!!!!!
ASDR

CARTOON by

DR MAHENDER SINGH RATHORE
Plant Biotechnology Unit
Jodhpur 342010 Rajasthan



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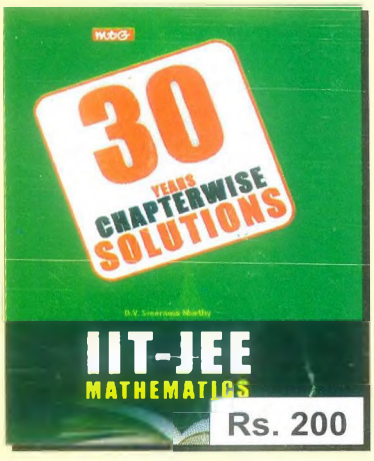

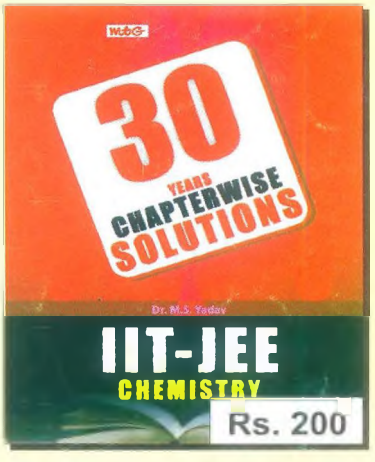

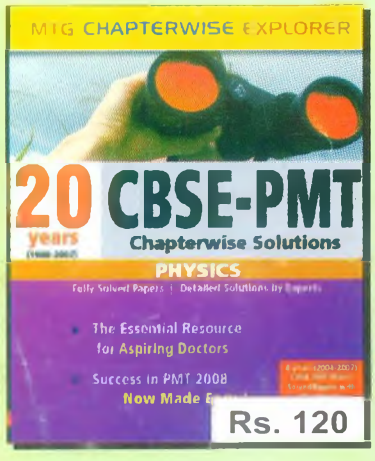

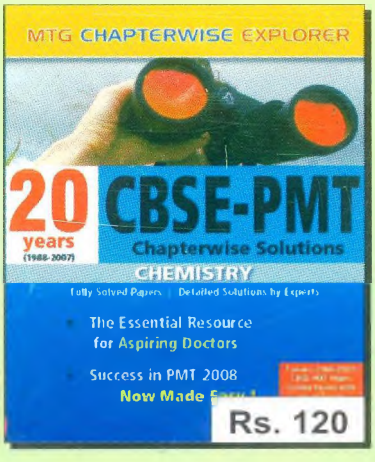

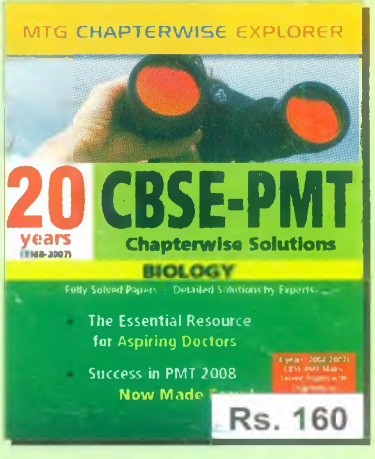

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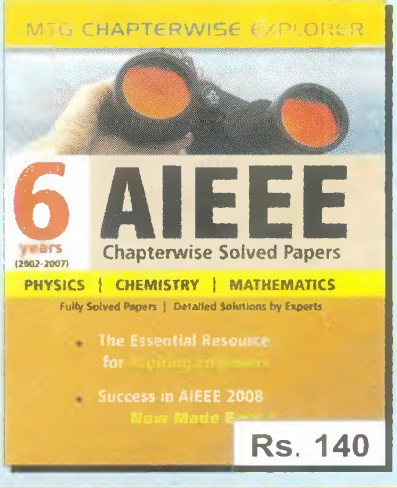

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